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Intellectual Property Rights Protection and Competitiveness of Academic Spin-Offs

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Bio

Cátia Cristina Pedrosa Ferreira was born on 20 of February 1992 in the city of Barcelos, district of Braga, Portugal. When completing her secondary school studies, she took an interest in the study of human behavior in its social and psychological aspects. In 2010, motivated by this interest, she decided to study Criminology in the Faculty of Law of University of Porto, graduating in 2014. During her degree she successfully completed an internship at the former *Direção Geral de Reinserção Social – Delegação Regional de Reinserção do Norte* (DGRSP-DRRN), current *Direção-Geral de Reinserção e Serviços Prisionais* (DGRSP), where she had the opportunity to learn practical skills on design of social policies and programs and community intervention, both in the educational and tutelary area, as well as in the field of criminal justice.

In order to improve her profile in view of the Portuguese job market, she decided to enroll in the master degree programme in Innovation and Technological Entrepreneurship, in the Faculty of Engineering at University of Porto. The main motivation was to look for new opportunities in a field that, despite appearing to be totally disconnected from the previous field, also sought to make the life of human beings easier by means of understanding their needs. Starting from a different perspective, this programme of studies strengthened previously acquired skills in opportunities and challenges analysis, now in a technological area but still maintaining a social and psychological dimension. This programme of studies allowed the candidate to cultivate an interest in Business Law and Intellectual Property management.

While pursuing her post-graduate studies, she completed a traineeship at a law firm, in the context of which she improved her problem solving skills while developing her legal interpretation, analysis and drafting skills with a focus on the drafting of contractual clauses.

Currently she is looking for new personal and professional challenges that uplive her main experiences and qualities.

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"Aqueles que passam por nós, não vão sós, não nos deixam sós. Deixam um pouco de si, levam um pouco de nós."
Antoine de Saint-Exupéry

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Resumo

As estratégias de gestão dos Direitos de Propriedade Intelectual (DPI) têm ganho uma importância crescente, especialmente no contexto académico, uma vez que as invenções geradas neste contexto estão muitas vezes na fronteira de grandes avanços científicos e os retornos da inovação necessitam de ser adequadamente apropriados.

Várias políticas públicas têm sido implementadas para encorajar e suportar financeiramente a criação de parques de ciência e tecnologia e incubadoras, na crença de que estas estruturas promoveriam o uso de mecanismos de proteção dos DPI pelas *Academic Spin-offs (ASOs)*, afetando, em última instância, a competitividade destas empresas. Contudo, existem muito poucos estudos quantitativos que provem/avaliem o impacto dos mecanismos de proteção dos DPI na competitividade das empresas.

O presente estudo visa preencher esta lacuna. Através de um inquérito direto dirigido a *startups* localizadas em parques de ciência e tecnologia e incubadoras, avaliamos o impacto direito e indireto (através do tamanho e intensidade de investigação e desenvolvimento) dos mecanismos de proteção dos DPI, globalmente e por tipos, na competitividade destas empresas.

Os resultados baseados numa amostra de 48 empresas sugerem que, de uma forma global, a proteção formal dos DPI é prejudicial à competitividade das empresas. Não obstante, quando os mecanismos de proteção dos DPI são discriminados por tipo, os resultados apontam que o uso de mecanismos de proteção informais, nomeadamente o tempo de aprovisionamento ou ciclo e os segredos comerciais, promovem a competitividade das empresas, ao passo que o uso de mecanismos formais de proteção, em particular as patentes, as marcas registadas e as denominações de origem, têm um impacto negativo nessa mesma competitividade. A dimensão e perfil de inovação da empresa intermedeiam a influência da protecção dos DPI na competitividade dessa mesma empresa.

Palavras-chave: Direitos de Propriedade Intelectual (DPI); *Academic Spin-offs (ASOs)*; Parques de ciência e tecnologias e incubadoras; *Startups*; Competitividade

Abstract

Intellectual Property Rights (IPRs) management strategies have obtained increasing attention, particularly in the academic context, because inventions generated in this context are often at the frontier of scientific breakthroughs and innovation returns need to be adequately appropriated.

Several public policies have been in palce to encourage and financially support the creation of science and technology (S&T) parks and incubators on the belief that these structures would foster the use of IPRs protection mechanisms by Academic Spin-offs (ASOs), affecting ultimately these companies' competitiveness. However, very few quantitative studies exist that prove/assess the impact of IPRs protection mechanisms on companies' competitiveness.

The present study aimed at fill this lacuna. Through a direct survey targeting startups located in S&T parks and incubators, we assessed the direct and indirect (through size and R&D intensity) impact of IPRs protection mechanisms, globally and by types, on the competitiveness of these companies.

Results based on a sample of 48 companies suggest that, globally considered, formal IPRs protection is detrimental to companies' competitiveness. Notwithstanding, when IPRs protection mechanisms are discriminated by type, results point that the use of informal protection mechanisms, such as lead time and trade secrets foster companies' competitiveness, whereas the use of formal protection mechanisms, in particular, patents, trademarks and geographical indications, negatively impact that same competitiveness. Size and the innovation profile of the company intermediates the influence of IPRs protection on the competitiveness of that same company.

Keywords: Intellectual Property Rights (IPRs); Academic Spin-offs (ASOs); Science and Technology (S&T) parks and incubators; Startups; Competitiveness

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1. Introduction

Intellectual property rights (IPRs) are the rights given to persons over the creations of their minds and usually encompass two main dimensions (WTO, 2015): 1) copyright and rights related to copyrights, and 2) industrial property, which includes inventions (protected by patents), industrial designs and trade secrets.

According Park, Lee and Jun (2015), most companies develop technologies in order to improve their competitiveness in the market and patent them around the world to protect their intellectual property. Competitive power of a company depends therefore on technologies developed by it (Banerjee, 2014).

The management of Intellectual Property (IP), especially in form of patents, has obtained increasing importance to small and medium-sized technology companies which adopt many different strategies to explore and exploit knowledge since research and development (R&D) to technology commercialization (Kay, Youtie and Shapira, 2014). Companies look for an effective IP management strategy which allows them to maximize returns to their investments in R&D of new technologies and innovative products, processes and services and to protect and possibly improve their competitiveness (Kay et al., 2014). In this sense, Bos, Broekhuizen and Faria (2015) suggest that companies can achieve competitive advantages only by effectively appropriating value from protection of knowledge of their innovation activities from uses of competitors.

Intellectual Property Rights (IPRs) management strategies are particularly important in the academic context because inventions generated in this context, although typically undeveloped, they are often at the frontier of scientific breakthroughs (Jensen and Thursby, 2001; Colyvas et al., 2002), with many and varied risks associated with validation, industrialization and commercialization of these inventions (Munari, Pasquini and Toschi, 2015). Sophisticated investors such as ventures capitalists (VCs) may be reluctant to invest in these ventures due to high transaction costs, information asymmetries (at least in early stages) about firm's market value and its potential growth and high risks related to the uncertainty of commercial potential (Murray, 2007; Gubitta, Tognazzo and Destro, 2015). This situation sometimes leads to a funding gap

to support technology transfer activities and Academic Spin Offs (ASOs)[1] (Munari and Toschi, 2014). However, high competition and rapid development of technologies have attracted a growing interest by governments in fostering the establishment of increasingly close relations between universities and industry to facilitate effective research and technology transfer (Teixeira and Mota, 2012; Wilson, 2012). More and more universities are successfully involved in creation and development of new high-growth technology businesses (Rasmussen and Wright, 2015). Therefore, governments and regional authorities from many countries have implemented public policies to encourage and financially support the creation of incubating infrastructures such as Incubators and Technology Accelerators (Rasmussen, Sørheim, 2012).

Some studies have concluded that the relationship between universities and support infrastructures such as Science parks and Incubators is strongly associated with the commercial performance of ASOs (Minguillo and Thelwall, 2015; Teixeira and Castro, 2015). However, so far there are few studies that have been working how ASOs grow and what kind of conditions and support structures facilitate their success (Rasmussen and Wright, 2015). Moreover, despite the (seeming) importance of Technology and Transfer Offices (TTOs), Science and Technology parks and Incubators in the process of defining the best IPRs management, the topic of IPRs management and the extent to which it contributes to ASOs' performance/competiveness has received little attention in the literature.

It is not yet clear how companies (including ASOs) choose intellectual property protection mechanisms in open innovation and how this choice affects their performance/competitiveness (Stefan and Bengtsson, 2014). Patents are the protection mechanism that attracts more attention in management research (McGahan and Silverman, 2006; Blind, Cremers and Mueller, 2009; Levitas and McFadyen, 2009). In contrast, mechanisms such as copyrights, lead time or secrecy have received much less attention from the literature (Bos et al., 2015). Additionally, some studies suggest that smaller companies, most notably technological startups (Block, De Vries, Schumann and Sandner, 2014), tend to choose informal protection mechanisms due the lack of resources (e.g., Olander, Vanhala and Hurmelinna-Laukkanen, 2014).

[1] Academic Spinoffs (ASOs) are new ventures generated within a university setting and based on technology derived from academic research (Rasmussen and Borch, 2010).

In this context, the present study aims primarily to assess the impact of IPRs protection mechanisms and types on the competitiveness of ASOs located in science and technology parks and incubators. Additionally, it intends to uncover the reasons weighting in the decision about formal or informal protection mechanisms, and how such choice affects firm performance/competitiveness.

In terms of structure, this dissertation presents the first two sections with a literature review on the issue of IPRs protection and competiveness. Then, in Section 3 the methodological underpins are briefly described. The empirical results are detailed in Section 4. Finally, Section 5 concludes the study highlighting the main outcomes, limitations and further avenues for future research.

2. IPRs protection and competiveness: literature review

2.1. Main concepts

IPRs protection and competitiveness have been connected discursively since 1970s, although in a more prevalent way during the late 1970s and 1980s, when IPRs protection started to be framed as a competitiveness issue (Muzaka, 2013). The importance of IPRs was recognized at first with two treaties administered by the World Intellectual Property Organization (WIPO): the Paris Convention for the Protection of Industrial Property in 1883 and the Berne Convention for the Protection of Literacy and Artistic Works in 1886 (Cottier, 1991).

Given the multitude of definitions that have been developed around these concepts, it is necessary first of all to operate a real 'epistemological rupture'. In fact, one of the difficulties that have been recurrent in the research of IPRs and competitiveness is related with the definition and harmonization of these concepts (Martín-de Castro, 2014).

2.1.1. IPRs

According to the World Intellectual Property Organization (WIPO), intellectual property (IP) "refers to creations of the mind: inventions, literary and artistic works, designs and symbols, names and images used in commerce".[2]

In the literature we find essentially two types of IPRs definitions: those which are focused in its nature and those which are focused in its function.

A definition of the first type is, for instance, the definition provided by World Trade Organization (WTO) that considers IPRs as rights of exclusive use granted to people for their mental creations for a certain period of time.[3] The second type of definitions emphasizes the relationship between IPRs protection and competitiveness.

Regarding the first type of definition, it is common to divide intellectual property into two branches: industrial property, which is obtained upon completion of filing and registration formalities, and copyright and rights related to copyright (sometimes

[2] In World Intellectual Property Organization. What is Intellectual Property? Retrieved November 1, 2015, from http://www.wipo.int/about-ip/en/.
[3] In World Trade Organization. What are intellectual property rights? Retrieved November 1, 2015, from https://www.wto.org/english/tratop_e/trips_e/intel1_e.htm.

referred to as “neighbouring”), usually obtained automatically, not depending on any formalities.

Industrial property includes a variety of protective rights aimed at conferring an exclusive monopoly on the exploitation of an intellectual creation related to industry and commerce, but also to agricultural and extractive industries and all manufactured or natural products (Article 1 (3) of the Paris Convention for the Protection of Industrial Property).[4]

From a utilitarian point of view we can say that industrial property protection takes place in two areas: one characterized by the protection of distinctive signs and another which includes patents for inventions, industrial designs and trade secrets.

The protection of distinctive signs relates specifically to trademarks, which distinguish the products and services of a company from other companies, and geographical indications, which allow the identification of the geographical origin of a product by the presence of certain features. Therefore, this kind of protection stimulates and ensures fair competition between companies, on the one hand, and protects consumers, allowing them to make informed choices between the other products and services provided, on the other hand.

The protection may last indefinitely, provided the sign in question continues to be distinctive.

The patents, industrial designs and trade secrets aim primarily to stimulate innovation by protecting the results/returns of the investment in R&D of a new technology. Notwithstanding this main purpose, this kind of protection should also facilitate technology transfer through foreign direct investment, joint ventures and licensing. It is usually given for a finite term (typically 20 years in the case of patents).

Copyright relates strongly to the economic exploitation of artistic and literary creations generally referred to as ‘works’, since that this kind of protection gives the holder the exclusivity of making copies. These ‘works’ covered by copyright include, but are not limited, to novels, films, music, paintings, photographs, architectural design, maps, sculpture, books and other writings, advertisement, software creations and databases.

[4] In World Intellectual Property Organization. Paris Convention for the Protection of Industrial Property. Retrieved November 5, 2015, from http://www.wipo.int/treaties/en/text.jsp?file_id=288514#P81_6245.

In turn, author's rights, typical of the civil law countries, refers more strongly to the person behind the creation and accordingly go further, recognizing and protecting not only its right to economically benefit from the exploitation of the creation, but also to its moral rights to be recognized as the creator and to ensure the respect of the work´s identity. Author's rights remain for a minimum period of 50 years after the death of the author.

Finally, "related rights" or rights related to copyright are similar or identical to those of copyright, although sometimes more limited and of shorter duration. The beneficiaries of related rights are: performers (such as actors, singers and musicians), producers of phonograms (sound recordings) and broadcasting organizations in their radio and television programs.

The main social purpose of protection of copyright and related rights is to encourage and reward creative work.

Regarding the second type of definition - which emphasizes the relationship between IPRs protection and competitiveness - IPRs are tools of market regulation, which shape the competitive configuration, being able to change it completely (Ramello, 2005). In fact, IPRs, by definition, not only give to their holders a portion of market power, protecting them from competition, as well as give them sometimes monopoly power. In this sense, companies have used IPRs, not only as a tool to attract investment, but also as building block of their own business strategy to obtain competitive advantage and maximize revenues (Singh, 2015).

IPRs allow companies to commercialize products and services or to license innovation which is detailed and codified through the legal system (European Commission, 2014), preventing that firm's innovations are exposed without any kind of protection and explored by the competitors (Singh, 2015).

2.1.2. Competitiveness

Competitiveness is a multidimensional concept that can be looked at from different levels: country/region, industry and firm level (Fagerberg, 1996; Ajitabh and Momaya, 2004; Cetindamar and Kilitcioglu, 2013; Papalia, Calia and Filippucci, 2015).

Focusing on the firm level, firm competitiveness can be defined as the capability of the firm to meet the customer needs in a profitable and sustainable way (Chikán, 2008). The

great difficulty of the companies lies here in providing, in a profitable way, goods and services that have more value to the customers than those that are provided by competitors, at the same time they are continuously developing adaptation initiatives to fit fast-changing market conditions, as well as the economic norms.

Another definition, provided by Cetindamar and Kilitcioglu (2013), realizes firm competitiveness as the capacity of the firm to compete with the others in a specific market, to increase its market share and to enter in international markets. These authors consider firm performance (output), firm resources (input) and the management processes these resources as key pillars of firm competitiveness, allowing companies to grow and be profitable in a sustainable way. Such capability cannot be considered sufficient condition to lead the firm to success. It only means that the firm has the ability to compete with the other companies, being the success merely an opportunity included in this capacity that may or may not be grasped through a proper management of the firm's everyday operations.

The definition developed by the Research Centre for Competitiveness (see Gál, 2010) seems, however, be the most comprehensive: firm competiveness encompasses "the company's ability to permanently offer consumers products and services, which are in compliance with the standards of social responsibility, and for which they are willing to pay more than for the competitors' products, ensuring profitable conditions for the company. Condition of this competitiveness is that the company should be able to detect changes in the environment and within the company, by performing permanent better market competition criteria compared to the competitors" (Gál, 2010: 3).

From this definition, it is possible to identify some basic competitiveness features, namely the ability to ensure the "efficiency" in the use of resources and the ability to achieve economic goals ("effectiveness").

Despite competitiveness being recognized as a multidimensional concept that is based on different aspects of the complex economic activity, there is a lack of studies that measure companies' competiveness in its multiple dimensions (Papalia et al., 2015).

The competiveness composite indicator at micro level, proposed by Papalia et al. (2015), based on Fischer and Schornberg's findings (2007), provides a multidimensional economic performance index that can be used to measure competitiveness. According to these authors, the competitiveness of a company can be

measured in three dimensions: efficiency, effectiveness and growth indicator. Efficiency is related to the degree to which the outputs are generated from inputs and reflect how well resources are used. Effectiveness is related to the ability to achieve stated goals. Since the ultimate goal of a firm is to get income, effectiveness can be referred to the firm's ability to compensate its employees and provide returns to its owners. Lastly, growth indicator is a dynamic component of competitiveness.

2.2. IPRs protection as source of competitive advantage

Nowadays, IPRs protection, more than being used by companies as a tool to attract investment (Glass and Saggi, 2002; Smarzynska, 2004) and create wealth (Braga and Fink, 2000; Schneider, 2005), has been recognized as a source of competitive advantage (Singh, 2015).

On the one hand, IPRs protection prevent that firm's innovations are exposed without any kind of protection and explored by the competitors, giving to the companies a portion of market power and sometimes monopoly power materialized in the exclusivity use and commercialization of their innovations that are legally protected from potential violations (Sey, Lowe and Poole, 2010).

Depending on the type of IPRs protection used, it seems to help companies to create and sustain competitive advantage in several ways (Reitzig, 2004): it can provide a temporary technological lead (incumbency advantages), protect strong brands and help to establish a standard in the market and to protect key components increasing switching costs.

The use of patents by companies is capable to provide a temporary technological lead but also shape industry structure (Reitzig, 2004). Patenting of incumbent products may discourage the establishment of new businesses, operating as a barrier in the market for the competitors, especially in sectors whose development and approval are more time-consuming and costly (e.g., health care sectors) (Calabrese, Baum and Silverman, 2000), at the same time that favors the development of economies of scale by the companies that owns the patent. In order to sustain competitive advantage, companies can opt to use a patent fence, which consist in protect not only the core invention of the product developed but also a set of substitutes, which can be easily constructed by the competitors (Cohen, Nelson and Walsh, 2000).

Trademarks and geographical indications allow companies to produce products and services with consistent quality which cannot be produced by competitors imitating their distinctive marks (Fisher, 2001). For this reason, they can protect strong brands, forming a promotional advantage (Reitzig, 2004).

IPRs protection can also be used to increase switching costs, either establishing a standard in the market, since that technologies further developed are assigned to fit or be compatible with the standard, either protecting key components for the functioning of patented technology (Reitzig, 2004), which provides to the company holding the protection a certain market monopoly in the production and commercialization of these components.

On the other hand, it fosters creativity and innovation of businesses, which are as well a measure of firm performance. It encourages companies to invest their resources in R&D of new and innovative products and services, due to the expectancy of appropriation the full returns thereof, if it is granted to the company an adequate and stricter protection regime of its innovations, with severe legal sanction for those who attempt copy or imitate them (Colson, 2001; Mani and Nelson, 2013); otherwise the prevalence and scope of innovation most likely decreases. In other words, it operates as a safeguard for creators, innovators or producers, since they feel comfortable to invest time, money and efforts on research and development of new technologies and products, knowing that they belong to them even that they will not be successful (Singh, 2015).

In this sense, IPRs protection assumes particularly strategic importance for smalls companies because the success of these companies depends a lot on creativity and innovation of products and services provided (Singh, 2015). Some of them are dedicated to creating new products, services and processes, other are specialized in adapting existing technologies to specific market niches. Furthermore, IPRs protection also allows to these companies the development of innovative business models (Singh, 2015).

Competitiveness has been associated with IPRs protection of radical innovations that introduce technological breakthroughs and contribute to the vertical differentiation of products and services provided by several companies (Reitzig, 2004). Prior studies have shown that startups play a key role in the generation of radical innovations (Colombo,

Doganova, Piva, D'Adda and Mustar, 2015). Therefore, an adequate IPRs protection in this type of companies can impact their competitiveness.

The use of patents and trademarks have been widely used throughout the industrial history to obtain competitive advantage (Singh, 2015), as well as business method patents (Vaver, 2006). Especially in small businesses, patents and trademarks, as well as industrial design and copyrights, seem to be very useful in textile, toy, publishing, biotechnology and retail industries sectors, among others (Chaudhuri, Goldberg and Jia, 2003; WIPO, 2006).

Taking the arguments above, we hypothesize that:

H1: Companies that protect their assets are more competitive.

2.3. IPRs as appropriation strategy and firm competitiveness

The literature has suggested that IPRs protection responds often to the appropriability problem of knowledge (Greenhalgh and Rogers, 2007). Nevertheless, there are some factors that influence the choice by the companies of (formal or informal) protection mechanisms as appropriation strategy which allows them to protect an innovation from imitation and achieve innovation returns improving their competitiveness.

According to Leiponen and Byma (2009), the appropriation strategies picked by the companies are qualitatively different whether they are small or large companies.

In fact, the majority of small and medium enterprises (SMEs) prefer informal protection mechanisms instead of IPRs protection because they considered them more familiar, cheaper and less time-consuming. Moreover, they tend to be considered more effective in some cases[5] greatly because the operating knowledge in this type of companies is predominantly tacit (Macdonald, 2003; Jensen, Morgan, Weatherall and Webster, 2005) and therefore it cannot be converted into coded information (Thomä and Bizer, 2013).

Other reasons for SMEs to use less IPRs than large companies are the poor awareness about IPRs protection benefits to the business context, the perception of IPRs protection as an expensive and complicated process and the greater difficulty in obtaining and enforcing this kind of protection (Cohen, 1989; Lanjouw and Schankerman, 2004; Macdonald, 2004). The literature has shown that SMEs have been less successful in the

[5] Only small companies that invest heavily in R&D and have partnerships with universities are more inclined to consider patents the most effective protection tool (Thomä and Bizer, 2013).

patent applications than large companies due the insufficient knowledge of the IP system, lack of information, poorly developed applications and low access to the legal counseling (Sey et al., 2010).

However, owners of small companies do not consider the granting of IPRs protection an obstacle to the success of the appropriation of returns from their innovations because they only choose IPRs over informal protection mechanisms under specific conditions wherein acquisition and enforcement costs are insignificant compared to the potential benefits of its use (Thomä and Bizer, 2013). In other words, the decision of small companies to protect or not IPRs seems to be the result of weighting costs and benefits of the use of formal protection methods.

Actually, several studies have relativized the importance of IPRs as a way of obtaining innovation returns highlighting lead time, secrecy and complementary assets as appropriation methods which in some cases are more effective than patents (Cohen et al., 2000; Laursen and Salter, 2005).

Sey et al. (2010) confirmed that SMEs, in order to protect their innovations, have chosen to use informal methods such as trade secrets, product quality maintenance, customized services and continued innovation, more than formal IPRs protection methods, which have not been used as a competitive advantage. IPRs protection is only relevant for the SMEs competitiveness if it was considered an integrated approach that takes in account several factors such as the knowledge of the benefits of an adequate IPRs protection, the access to the proper IPRs protection services ensuring an effective IPRs enforcement, at the same time that are undertaken others competitive strategies such as the improvement of products and services quality provided, protection of cultural artefacts and dissemination of national trademarks (Sey et al., 2010). From this point of view, an increase of the IP registration and the enforcement of the IPRs protected per se do not ensure an increase in SMEs competitiveness.

Although in small companies the use of informal protection mechanisms seems to be more profitable in terms of the appropriation of innovations returns, these appropriation methods are sometimes considered more valuable when they are complemented with some kind of IPRs protection (Thomä and Bizer, 2013). This demonstrates that the adoption of appropriation strategies that results from the combination of different

formal and informal protection mechanisms may be advantageous and that these mechanisms are not mutually exclusive.

According Thomä and Bizer (2013), apart from the size of the companies a key factor in choosing formal or informal protection mechanisms, the business context (more innovative or less innovative) seems to be equally important. These authors suggest that the most innovative companies, due its greater investment in R&D, feel more need to protect their innovations with patents in order to achieve the returns of thereof, differently from the companies that invest less in innovation. Large companies use more often IPRs protection due their increased commitment to R&D. They are generally characterized by introducing new innovations to the market. In contrast, SMEs, due to their great responsiveness to fast-changing market conditions, usually bet in an incremental improvement of the quality of existing products and services focusing on the customer needs (Baldwin and Gellatly, 2003; Mazzarol and Reboud, 2009). As such, IPR protection arouses less attention.

Moreover, appropriation strategies also differ depending on the type of innovation considered (Thomä and Bizer, 2013): product innovation or process innovation. These authors found that product innovations tend to be protected using informal protection methods or also IPRs. In turn, non-protection of process innovations seems to be equally effective as other appropriation strategy.

Taking the arguments above, we hypothesize that:

H2: *The type of IPRs strategy - formal vs. informal - influences the competitiveness of the companies.*

H3: *The size of the company intermediates the influence of IPRs protection on the competitiveness of that same company.*

H4: *The innovation character of the company intermediates the influence of IPRs protection on the competitiveness of that same company.*

In summary, there are essentially three factors that influence the choice of IPRs protection as appropriation strategy by companies, which allows them to protect an innovation from imitation and achieve innovation returns improving their competitiveness: companies' size, the innovation profile of the firm, and the business context (e.g., region, sector). Despite the importance that companies' size seems to have in the choice of (formal or informal) protection mechanisms as competitive strategy, the

business context where the companies operate, and the innovation profile of the firm are equally important. Figure 1 shows the integrated conceptual framework and the hypotheses to be tested.

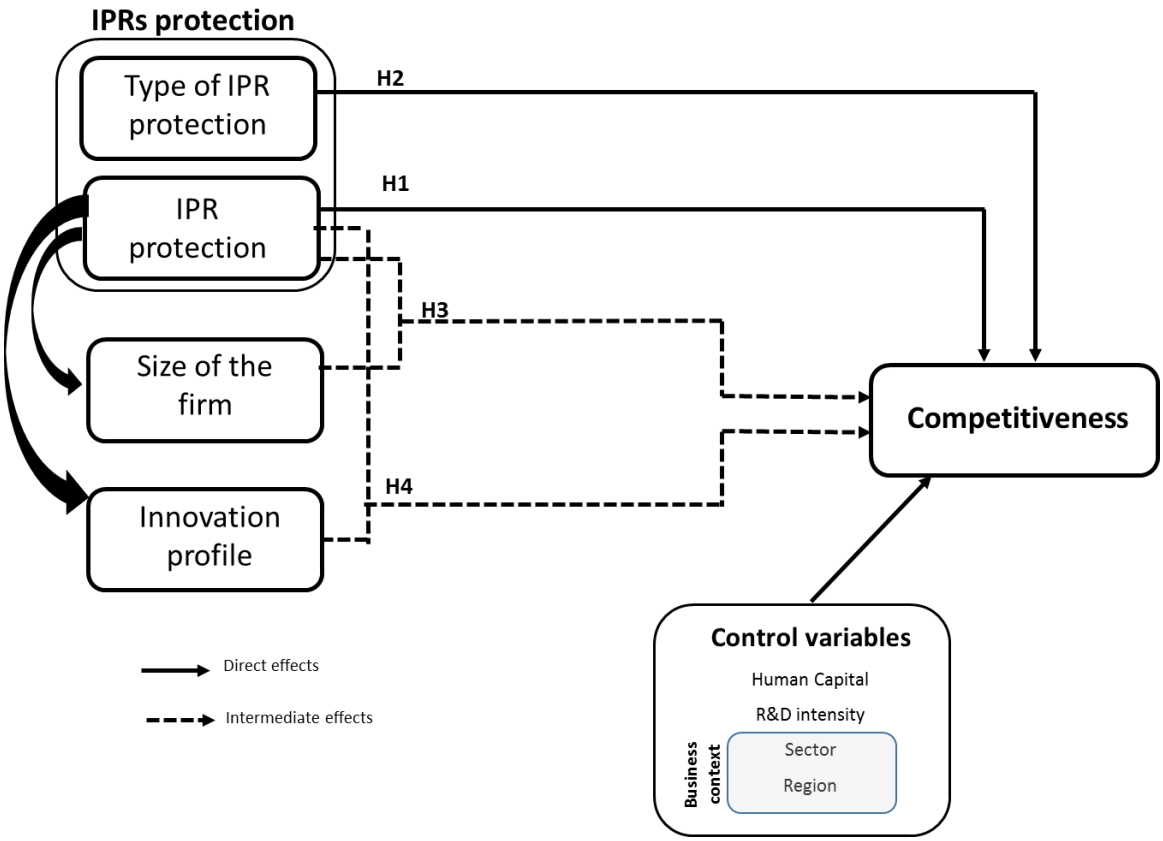


Figure 1: The integrated conceptual framework

Source: Own elaboration.

3. Methodology

3.1. Aim of the study

The present study intends specifically to assess the impact of IPRs protection mechanisms on startups' competitiveness. Such purpose differs from that of the qualitative studies carried out by Reitzig (2004; 2007) and Sey et al. (2010), whose main aims were to explore IPRs protection management strategies.

It targets Academic Spin-offs (ASOs), most precisely, startups located in science and technology parks and incubators. Despite the (seeming) importance of science and technology parks and incubators in the process of defining the best IPRs management, the topic of IPRs management and the extent to which it contributes to ASOs' performance/competiveness has received little attention in the literature. It is not yet clear whether and which type of intellectual property protection mechanisms these startups choose and how these choices affect their performance/competitiveness (Stefan and Bengtsson, 2014).

Given that no relevant information is publicly available on these issues, it was necessary to collect information from primary sources, the companies. We therefore collected information through a survey in a similar way of some authors who have made efforts to discover which appropriation strategies are chosen by small companies (e.g., Leiponen and Byma, 2009; Thomä and Bizer, 2013) and how these strategies affected firm performance (e.g., Calabrese et al., 2000; Cohen et al., 2000; Laursen and Salter, 2005).

Given our purpose, the most adequate methodology of analysis is the quantitative one (see Creswell, 2014), most notably causality/multivariate econometric techniques, which we detail futher ahead, in Section 3.3.

Table 1 summarizes main studies analyzed and the respective methodologies of analysis.

Table 1: Main studies analyzed and the respective methodologies of analysis

Author(s)	Aim of the study	Data gathering methodology	Methodology of analysis	Techniques/ methods of analysis used	Number of companies	Period of reference	Type of companies	Sector	Country of analysis
Sey, Lowe and Poole (2010)	To explore the use of IP, especially trademarks and industrial designs, by MSMEs in Ghana	Interviews	Qualitative	Case studies	10	2010	MSME	Textiles, garments, footwear, accessories, natural/herbal products and arts/crafts industries	Ghana
Reitzig (2004; 2007)	To understand how IPRs matters are managers by corporate IP managers			-	34	2003-2005	Large	-	Copenhagen
Thomä and Bizer (2013)	To discover what appropriation strategies are chosen by innovative small companies	Survey	Quantitative	Cluster analysis Factor analysis	1624	2002-2004	Small companies	Manufacturing and service	Germany
Leiponen and Byma (2009)	To examine small companies' strategies for capturing returns to investments in innovation			Multinomial logistic maximum likelihood	936/830	2002/2003		All economic sectors except agriculture, finance and real estate	Finland
Laursen and Salter (2005)	To explore how legal (such as patents) and first mover (such as secrecy) appropriability strategies shape performance			Tobit regression analysis	2707	2001	All	Manufacturing	UK
Cohen, Nelson and Walsh (2000)	To explore why companies patent despite reporting patents to be relatively ineffective (for most industries) in protecting returns to innovation			Factor analysis	1165	1991-1993			US
Calabrese, Baum and Silverman (2000)	To analyze how incumbent biotechnology companies' patenting and alliance-building activities shape rates of founding in the Canadian biotechnology industry	Documentary analysis		Poisson regression	151	1991-1997	Startups	Biotechnology	Canada

3.2. Data gathering process

3.1.2. Target population

Due to the time and resources constraints, it would be impossible to include in this analysis all Academic Spin-offs (ASOs)/startups located in Portuguese science and technology parks and incubators. Notwithstanding, previous studies (see Teixeira, 2016) show that ASOs are concentrated in 4 main science and technology parks and incubators located in Portugal mainland: UPTEC, associated with University of Porto; Instituto Pedro Nunes (IPN) Incubator and TecBIS, associated with University of Coimbra; TAGUSPARK, associated with University of Lisbon; and UAlgCria associated with University of Algarve. Geographically, these four science parks cover all NUTs II region of Portugal mainland and encompass a set of diversified activities/business sectors.

In order to select the companies to be anlysed we established a minimum period of three years in business in order to be able to get data from the three last years. Additionally, given that we were aiming startups we considered, in the line of the most recent 'European Startup Monitor' (ESM, 2016), only those companies with ten or less years in business.

3.2.2. Describing the survey

The survey administered to the companies was built from scratch because there was no surveys developed in this research area that could serve as a model. Nevertheless, its construction was made from an extensive and updated literature review of the variables under analysis, which allowed that the drawing up of the survey were the more focused as possible to obtain only the information that were strictly necessary to reach the objectives of investigation. The concern with the brevity of the survey was also motivated by the need to achieve a reasonable response rate.

We chose to elaborate an online survey[6] for several reasons: great reach at the lowest possible cost - it allows to reach a large number of companies from different geographical locations almost with no cost; quality and reliability of answers - it allows people to respond at the time that it was most convenient to them, without the influence

[6] The Portuguese version of the online survey is available in https://docs.google.com/forms/d/1duIJM1-uIp2I8ctAYx_c13R1lvPvoCF5OEi_RR-Lwoc/viewform.

of the researcher; highest profitability of time - it allows a real-time responses monitoring and to export collected information to a spreadsheet.

Considering that the target respondents were Portuguese, the online survey was written in Portuguese.

The survey's structure includes 9 sections, being the first a brief introduction to the survey. The second section corresponds to the descriptive features of companies, including company name, 5 digit economic activity code, foundation year, number of employees and number of employees in full-time equivalent.

The third section concerns the collection of information about the use and importance to the company of the assets protection mechanisms, namely patents, trademarks, industrial design, trade secret, geographical indications, copyright and rights related to copyright, lead time and complementary assets.

The fourth section focuses on the major reasons for using these assets protection mechanisms, being suggested three main reasons (simplicity in the utilization and implementation, low cost and effectiveness in terms of protection), plus 'other reason(s)' (an open question).

The fifth section refers to the purposes of using of the distinct types of assets protection mechanisms, including: attract funding; attract investment; obtain market power; use and exclusively commercialize a product or service; gain competitive advantage; protect an innovation from imitation and exploitation by competitors; increase market competitiveness; increase market share; and enter into the international markets.

The remaining sections are related to other business indicators: sections six, seven and eight gather information about the turnover/sales (in Euros), gross value added (in Euros) and EBITDA value (in Euros) for the last three years. These sections were designed to measure the competitiveness in two dimensions – efficiency and effectiveness -, in line with Papalia et al. (2015). Efficiency related performance measure is the productivity (value added per employee), which is often used to measure competitiveness and is a good indicator of long term competitiveness (Reinert, 1995; Fischer and Schornberg, 2007). Accordingly, to measure efficiency of the companies we used average Gross Value Added (GVA) per capita for the last three years. Effectiveness is proxied by profitability which is reflected by company's average EBITDA for the last three years.

Finally, section nine refers to R&D intensity and the weight of PhDs employees in total of employees.

Table 2 summarizes the present study main variables and the corresponding relevant survey questions.

Table 2: Present study main variables and the corresponding relevant survey questions

	Variable	Theoretical Dimension	Measure	Sections in the online survey	Question in the online survey	Period of reference
Dependent	Competitiveness	Efficiency	Productivity	7. Other business indicators: gross value added (in Euros)	35-37	2013 - 2015
		Effectiveness	Profitability	8. Other business indicators: EBITDA value (in Euros)	38-40	
		Growth Indicator	Annual Change of Turnover	6. Other business indicators: turnover/sales (in Euros)	32-34	
Independent	IPRs protection	Formal and informal protection mechanisms: ▪ Patents ▪ Trademarks ▪ Industrial design ▪ Trade secret ▪ Geographical indications ▪ Copyright and rights related to copyright ▪ Lead time ▪ Complementary assets	Use and importance	3. Use and importance, to the company, the assets protection mechanisms	6-13	2006 - 2013
			Reasons for using	4. Major reasons for using the assets protection mechanisms	14-21	
			Purposes of using	5. Purposes of using the assets protection mechanisms	22-31	
Control	Descriptive features of companies	Human capital	Weight of PhDs employees in total of employees	9. Other business indicators	42	
		R&D intensity	R&D intensity		41	
		Business context (Sector and Region)	Company name and 5 digit economic activity code	2. Company description	1 e 2	

3.2.3. Data gathering procedures

Although the targeted companies were located in science and technology parks and incubators with online websites, the information about these companies was limited to their name, business sector and contacts. For this reason, the process of data collection was very time consuming, requiring a lot of effort and dedication over four months.

The first phase of data collection was focused on gathering information about the foundation year of all companies located in science and technology parks and

incubators as only those in business at least three years but not more than ten were to be selected for further analysis. We built 4 databases (one for each park or incubator) containing the following information: company name, business sector, foundation year and contacts. These databases were built with information found in the online websites of the parks or incubators and, by reference, in the websites of the companies themselves, when existent.

Finding the foundation year of the companies was not an easy task, since such information was, in general, inexistent in the parks or incubators'/companies' websites. For this reason, it was necessary to establish email and phone contacts with the companies in order to obtain this information in a reliable manner.

On the 17th February 2016 an email was sent to all relevant companies, totalling almost 355 companies (168 from UPTEC, 57 from IPN, 110 from TAGUSPARK and 20 from UAlgCria).

By email only 46 companies responded. Therefore, it was necessary to contact by phone all the companies that did not respond to the email in order to obtain information about their foundation year. This task was performed during nearly two months and it was completed on 31st March 2016.

In the end of the first phase, we obtain the 'effective' target population, composed by 162 startups of age equal or greater than three years and equal or inferior to ten years (82 from UPTEC, 31 from IPN, 37 from TAGUSPARK and 12 from UAlgCria).

In order to harmonize the sector of activity we used the *"Sistema de Informação da Classificação Portuguesa de Atividades Económicas"* (SICAE),[7] which is an online database that contains permanently updated and harmonized information about the code of activity of companies and similar entities. One by one each of the 162 startups activity codes were checked. Given that in some cases (17) there was a discrepancy between the name of companies disclosed in the online websites of the parks or incubators and name used in its commercial register, no result emerged from the online platform. Again, we contacted the companies by phone in order to solve the discrepancy.

Once this was done, we started preparing the online survey as well as the email to send to the companies. On the 28th April 2016, we sent an email to the 162 companies

[7] Available in http://www.sicae.pt/Consulta.aspx.

corresponding to our 'effective' target population asking them to cooperate in the online survey – the email letter is in Appendix A2.

Only 8 companies responded to the email in a period of one week. For this reason, on 5th May 2016 we sent a reminder encouraging companies to participate in the survey. Only 4 companies responded after one week of the reminder. Therefore, we decided to contact by phone all the (150) companies which had not previously responded. During almost two and a half weeks we dedicate our time to call each company, every working day from 2 p.m. until to 6:30 p.m..

In the first phone contact to the companies we started presenting us and presenting our research project, asking to be in contact with the person responsible for the company and/or a collaborator able to fill in the questionnaire. When in contact with that person, we again presented our research project. After this phone contact we got 11 additional answers. By this stage, we had 23 responses.

After few days, we established a second phone contact to the 139 companies that had not yet responded. This time we asked immediately to talk to the person with whom we spoke previously. This second phone contact was more fruitful, managing to obtain 26 additional responses. By then, 49 responses were obtained.

Due to time constraints (the need to meet the deadlines of the dissertation - end of June 2016), we decided to close the data gathering procedures by the end of May. Therefore, in the last week of May we establish a third and last contact with 113 remaining companies trying to obtain a maximum possible responses to the survey. Given the persistence of our contacts, some companies started to show some discontent. After this last phone contact we got 6 additional responses, which made a total of 55 responses. Due to incomplete responses, we had to exclude 7 responses. Thus, in the end of this process we got a final number of 48 responses to the survey - 23 from UPTEC, 8 from IPN, 10 from TAGUSPARK and 7 from UAlgCria -, representing an effective rate of response of 30%. The sample is fairly representative by technological infrastructure/location (see Table 3).

In our final database, each company was match to its park or incubator and the economic activity code to its designation, by consulting the *"Classificação Portuguesa*

das Atividades Económicas, Revisão 3", available in an online metadata system by the National Statistical Institute.[8]

In order to complete some economic data not answered in the survey, we used Sabi database, an online database which provides complete information of financial analysis of Portuguese and Spanish companies with a history of annual accounts up to 25 years.[9]

Table 3: Representativess of the sample

S&T parks or incubators	Target population		Sample		Rate of responses
	N	%	n	%	(n/N) %
UPTEC	82	51	23	48	28
IPN	31	19	8	17	26
TAGUSPARK	37	23	10	21	27
UAlgCria	12	7	7	14	58
Total	162	100	48	100	**30**

Lastly, we have established further phone contacts with some companies to clarify some data.

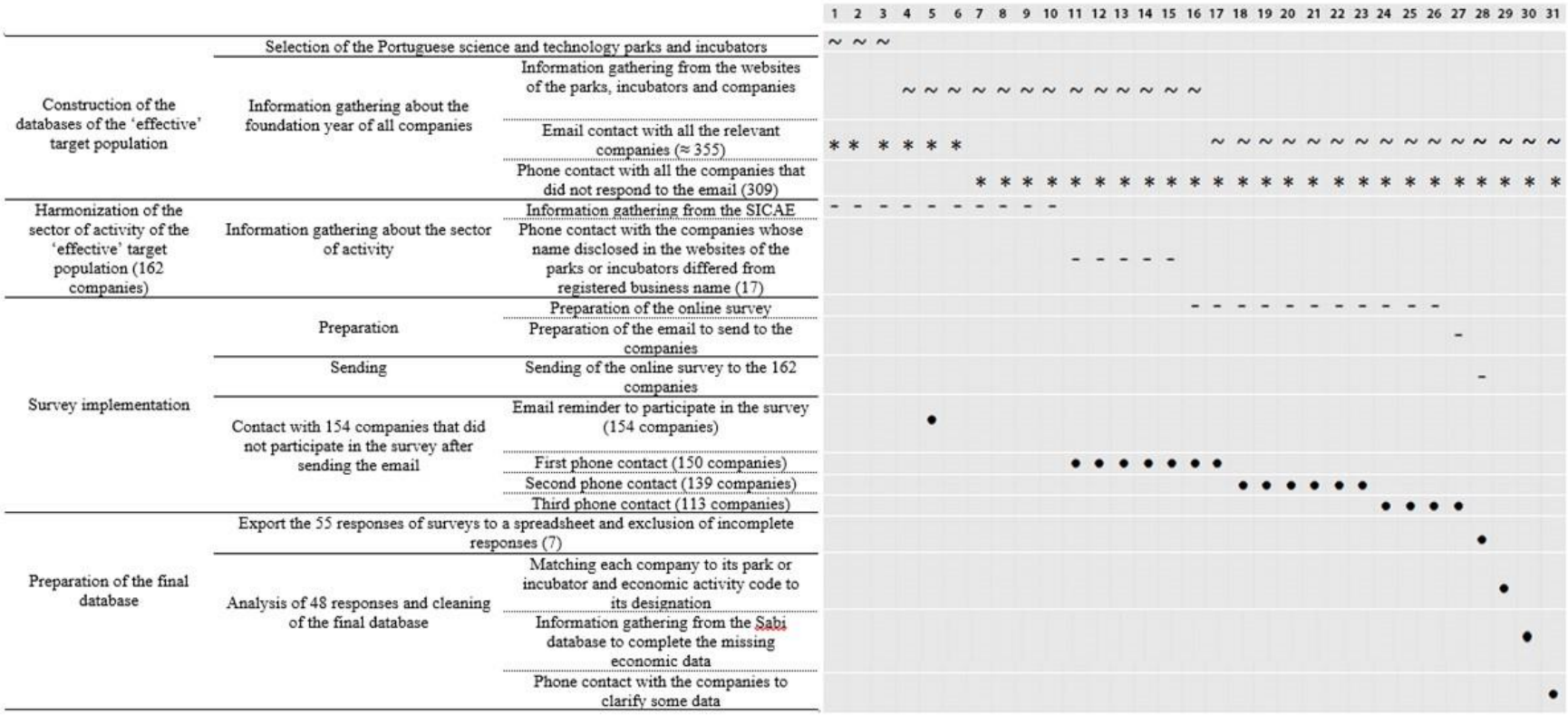
Figure 2 highlights the main tasks performed during the process of data collection as well as the time devoted to each of them.

3.3. Model specification

In order to complement the descriptive analysis and answer to the research question put forward – Do IPRs protection mechanisms matter for ASOs competitiveness? -, the present study resorts to a multivariate econometric model, more specifically, a logistic regression. In concrete, this estimation procedure enables us to assess how the various determinants, most noticeably IPRs, affects companies' competitivess.

According to our theoretical framework (see Figure 1), IPRs, IPRs types and the interaction between IPRs mechanisms and companies size and innovation profile is likely to impact of companies' competitivess taking into account business context (sector and region) and companies' human capital endowments.

[8] Available in http://smi.ine.pt/Categoria.
[9] Available in SIGARRA from FEP in Electronic Resources: Statistical and Financial Databases.



Legend: ~~~~~ February; ******* March; --------- April; • • • • May

Figure 2: Main tasks performed during the process of data collection and time devoted to each of them

Our dependent variable 'Top competitive company versus Non top competitive company' is a dummy-variable which assumes the value of 1 when the company is classified as top competitive in terms of three main economic indicators: sales per capita, gross value added (GVA) per capita and EBITDA. We considered the averages of these indicators over the three years period 2013-2015. To compute the top companies we took into account the percentile distribution of the three main indicators and considered the top 25% and top 50%. We thus have 6 distinct indicators for the dependent variable.

Being our dependent variable a dummy the adequate estimation model is the logistic regression because we cannot expect a normal distribution and we need to interpret the results as probabilities - this would not be possible with a conventional (OLS) estimation technique.[10] Therefore we resort to the general framework of probabilistic models.

According to the conceptual model the 'propensity of being top competitive', as referred earlier (*cf.* Section 2), depends on a set of determinants, most notably, IPRs mechanisms usage, the type of IPRs mechanism, the interaction between the use of IPRs and companies' size and innovativeness, human capital, R&D intensity, and business context (region and sector). These 'explanatory' variables are gathered in a vector *X*, which explains the outcome, so that:

$$\text{Prob}(Y=1) = F(X,\beta) \quad \textit{and} \quad \text{Prob}(Y=0) = 1 - F(X,\beta)\,.$$

The set of parameters β reflects the impact of changes in *X* on the likelihood of 'top competitiveness'.

The empirical assessment of the propensity of top competitiveness is based on the estimation of the following general logistic regression:

$$\boldsymbol{P(Top\ competitivess)} = \frac{\mathbf{1}}{\mathbf{1} + \boldsymbol{e^{-Z}}}$$

With

$$\boldsymbol{Z = \beta_0 + \beta_1 IPR\ use + \beta_2 IPR\ types + \beta_3 (IPR\ \times Size) + \beta_4 (IPR \times Innovatiness) + \beta_5 HC + \beta_6 R\&D + \beta_7 Sector + \beta_8 Region + \varepsilon_i}$$

[10] The distribution of errors is not normal and the predicted values cannot be interpreted as probabilities – they are not constrained to fall in the interval between 0 and 1.

Rewritten in terms of the odds (ratio of the probability that the event occurs to the probability of the event not occurring) of an event occurring, the *logit* model becomes:

$$log\left(\frac{Prob(Top\ Competitivess)}{Prob(non\ TopCompetitivess)}\right) = \\ = \beta_0 + \beta_1 IPR\ use + \beta_2 IPR\ types + \beta_3(IPR \times Size) \\ + \beta_4(IPR \times Innovatiness) + \beta_5 HC + \beta_6 R\&D + \beta_7 Sector + \beta_8 Region + \varepsilon_i$$

The logistic coefficient can be interpreted as the change in the log odds associated with a one-unit change in the independent variable. Then *e* raised to the power β_i is the factor by which the odds change when the i^{th} independent variable increases by one unit. If β_i is positive, this factor will be greater than 1, which means that the odds are increased; if β_i is negative, the factor will be less than one, which means that the odds are decreased. When β_i is 0, the factor equals 1, which leaves the odds unchanged.

The next section details the empirical results obtained by the statistical treatment of the gathered data.

4. Empirical Results

4.1. Descriptive results

Of the 48 respondent companies (23 from UPTEC, 8 from IPN, 10 from TAGUSPARK and 7 from UAlgCria), we found that 73.6% of these companies use informal protection mechanisms while 49.6% use formal protection mechanisms. In more detail, the informal protection mechanisms that are mostly used are the complementary assets and the lead time, whereas the most used formal protection mechanisms are the copyright and rights related with copyright and the trademarks (see Figure 3).

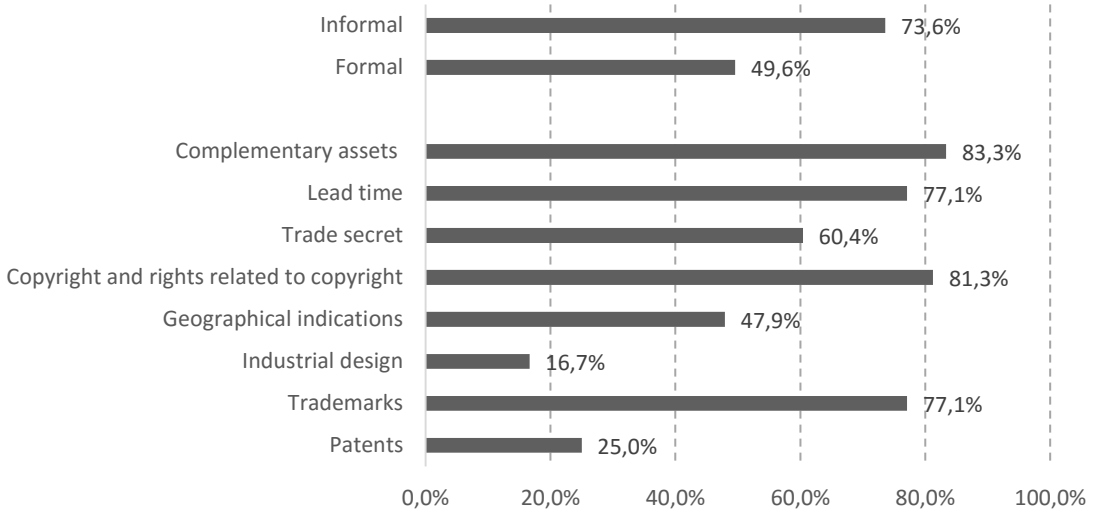


Figure 3: Average use of IPRs by companies

Source: Own computation base on primary data gathered from 48 startups.

Regardless the type of formal and informal IPRs protection mechanisms, the companies that use them justify their use by the effectiveness they bare in terms of protection (see Figure 4). This is particularly the case for patents (83% of the companies that use this IPR state that it is due to its effectiveness), trademarks (76%), and geographical indications (73%). The simplicity in the utilization and implementation is particularly important for 63% of the companies that use industrial designs. Low cost is only important for a reduced number of companies, and to a higher extent for companies that use trade secrets (21%), copyright and rights related to copyright (20%) and trademarks (19%).

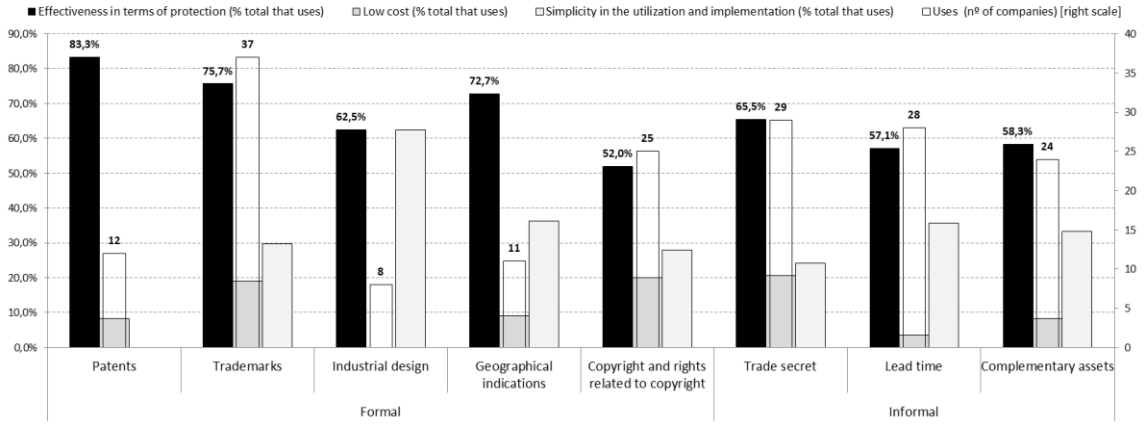


Figure 4: Number of companies that uses the IPR mechanism (right scale) and reasons for choosing each IPR mechanism (in % of the total number of companies that use the mechanism)

Source: Own computation base on primary data gathered from 48 startups.

It is important to analyse at this stage whether the differences on the average use of IPRs are contigent on a set of variables that characterize the companies, most notably: region (i.e., science and technology (S&T) park or incubator where companies operate), age, human capital, R&D intensity, existence of PhDs collaborators, and sector.

Regarding the region, we verify that both formal and informal protection mechanisms are more used by companies of IPN, although informal mechanisms are also widely used by companies of UAlgCria (see Table 4).

Considering formal protection mechanisms: patents are more used by companies of UPTEC and IPN; trademarks assume an average percentage of use similar for companies of all S&T parks or incubators, except Taguspark; industrial design are more used by companies of IPN; geographical indications are more used by companies of UAlgCria following companies of Taguspark; and copyrights and rights related to copyright are used in a similar extent by companies of all S&T parks or incubators.

Regarding informal protection mechanisms: trade secret are more used by companies of IPN and lead time and complementary assets take an average use in a similar proportion by companies of all S&T parks or incubators, with maximum value for companies of UAlgCria.

Notwithstanding the differences observed on the average use of IPRs by regions, the Kruskal-Wallis test allows us to conclude that these differences are statistically significant (at the 5% of significance) only for the use of industrial design.

To analyze if there were differences on the average use of IPRs according to the age of the companies, we grouped them into 3 age groups: 3-4 years, 5-7 years, and 8-10 years.

Table 4: Average use of IPRs by companies considering the region

IPRs	UPTEC	IPN	Taguspark	UAlgCria	Kruskal-Wallis test (p-value)
Patents	34.8%	37.5%	10.0%	0.0%	0.154
Trademarks	82.6%	87.5%	50.0%	85.7%	0.156
Industrial design	**13.0%**	**50.0%**	**0.0%**	**14.3%**	**0.037****
Geographical indications	39.1%	37.5%	60.0%	71.4%	0.372
Copyrights and rights related to copyright	78.3%	87.5%	80.0%	85.7%	0.933
Trade secret	60.9%	87.5%	40.0%	57.1%	0.247
Lead time	69.6%	87.5%	70.0%	100.0%	0.318
Complementary assets	78.3%	87.5%	80.0%	100.0%	0.580
Formal	49.6%	60.0%	40.0%	51.4%	0.397
Informal	69.6%	87.5%	63.3%	85.7%	0.235

Note: ** Statistically significant at 5%.

We found that informal protection mechanisms are used in a similar extent by companies of all age groups while formal protection mechanisms seem to be more used by companies that are included in the age groups of 3-4 years and 5-7 years (see Figure 5).

Considering formal protection mechanisms, patents and industrial design are more used by younger companies (3-4 years), trademarks are more used by older companies (8-10 years), and geographical indications are more used by younger and middle age companies (3-4, 5-7 years) as well as copyrights and rights related to copyright.

Considering informal protection mechanisms, trade secret assumes an identical average use by companies of all age groups, whereas lead time is more used by middle age companies (5-7 years) and complementary assets are more used by older companies (8-10 years).

Again, despite the differences observed, Kruskal-Wallis test leads us to conclude that these differences are statistically significant (at the 10% of significance) only for the use of copyrights and rights related to copyright.

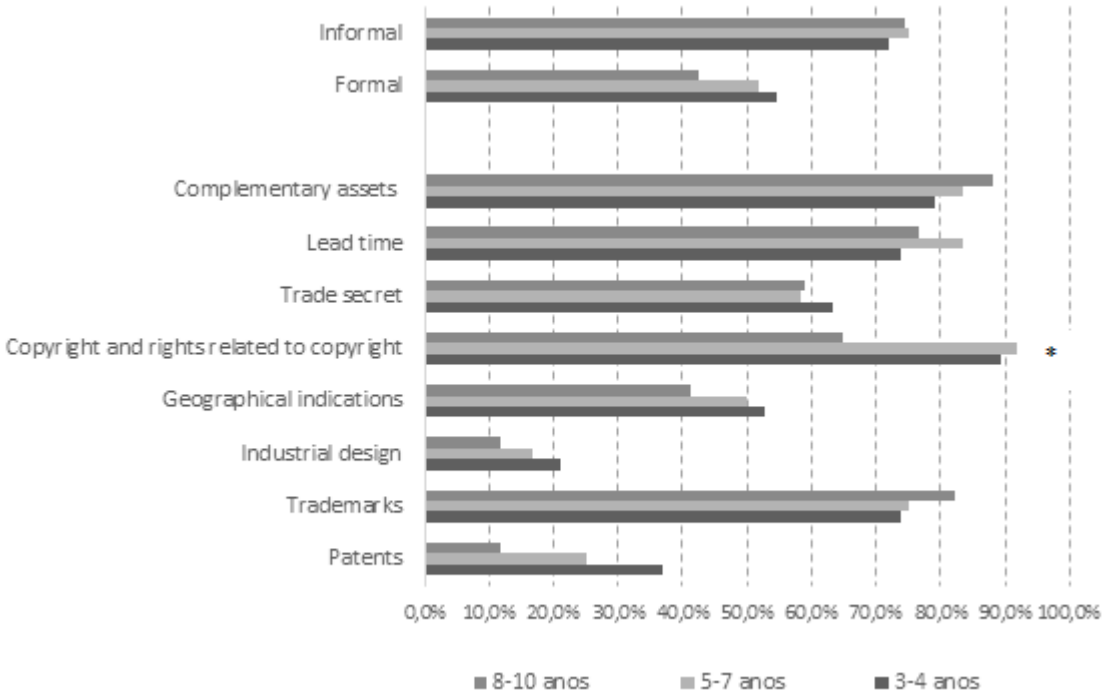


Figure 5: Average use of IPRs by companies considering the age

Note: * Statistically significant at 10%.

Source: Own computation base on primary data gathered from 48 startups.

In turn, we checked if there were differences on the average use of IPRs considering the companies' size, i.e., the number of collaborators that each company employs. Similarly to the previous variable (age), we grouped the companies into 3 categories taking into account the number of employees that they had: up to 3 collaborators, 4-9 collaborators, and 10 or more collaborators.

We found that informal protection mechanisms are more used by very small companies (those that have up to 3 collaborators), while formal protection mechanisms are more used by both very small companies and the largest ones (with 10 or more collaborators) (see Figure 6).

Considering formal protection mechanisms, patents and trademarks are more used by larger companies (with 10 or more collaborators), industrial design and geographical indications are more used both by smaller (up to 3 collaborators) and larger companies (10 or more collaborators), and copyrights and rights related to copyright are more used by smaller companies (up to 3 collaborators).

Regarding the informal protection mechanisms, trade secret seems to be more used by larger companies (10 or more collaborators) and lead time and complementary assets are more used by smaller companies (up to 3 collaborators).

Applying Kruskal-Wallis test, we demonstrate that none of the differences observed were statistically significant.

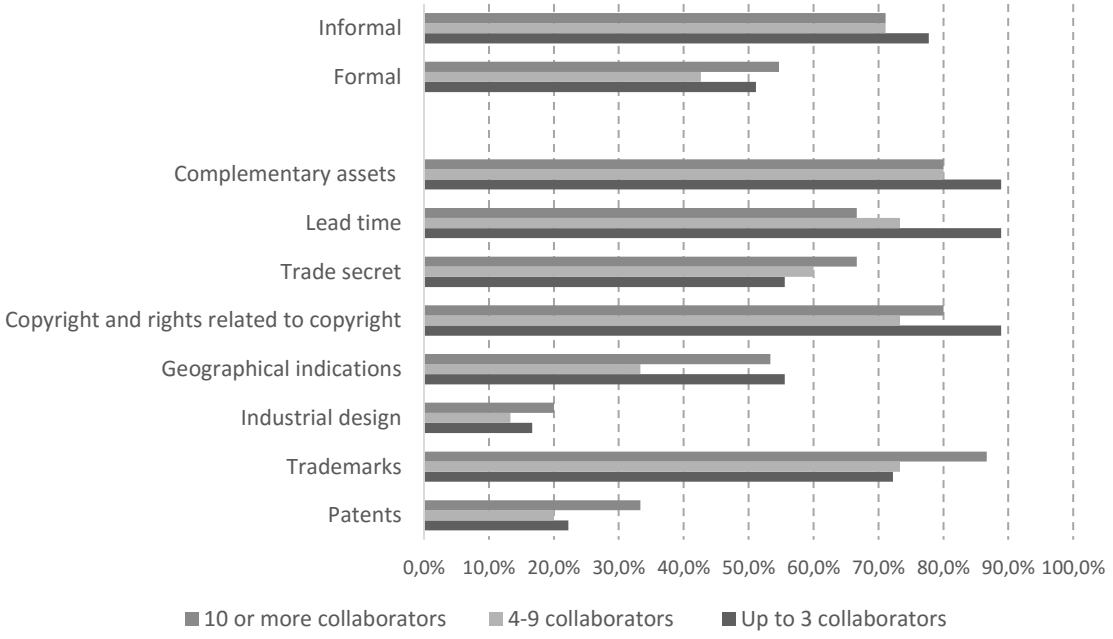


Figure 6: Average use of IPRs by companies considering the human capital

Source: Own computation base on primary data gathered from 48 startups.

In order to verify whether there were differences on the average use of IPRs according to companies' R&D intensity, we grouped the companies into 2 groups: companies with R&D intensity less than or equal to 50% and companies with R&D intensity above 50%.

We found that both formal and informal protection mechanisms are more used by highly R&D intensive companies, being such difference (according to Kruskal-Wallis test) statistically significant (at the 1% of significance) (see Figure 7).

We found that all protection mechanisms (formal and informal) are more used by highly R&D intensive companies and that these differences, with exception of the patents, copyrights and rights related to copyright and for complementary assets, are statistically significant.

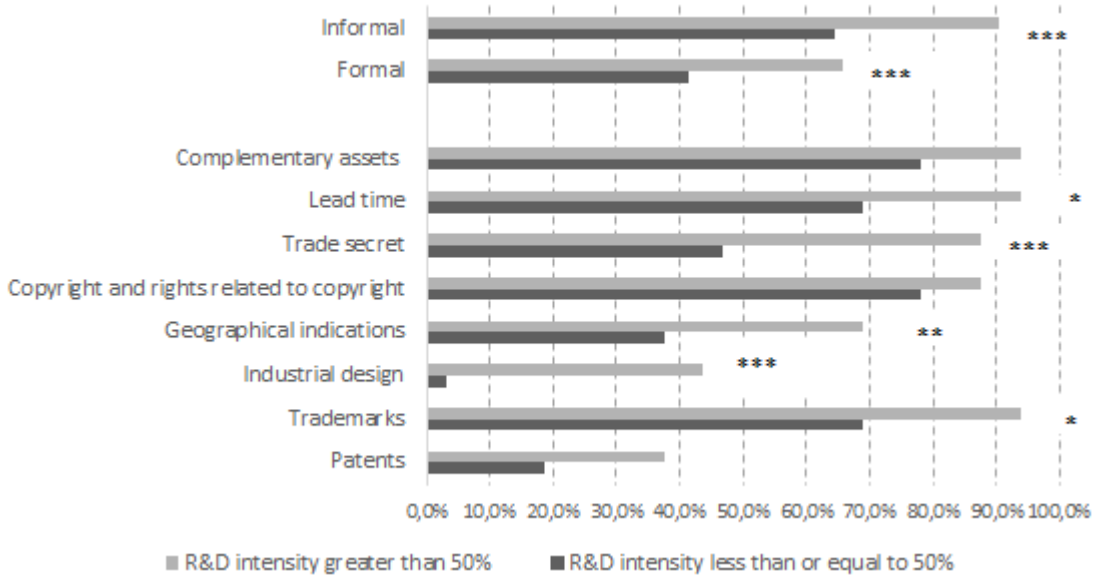


Figure 7: Average use of IPRs by companies considering the R&D intensity

Note: *** (**) [*]: Statistically significant at 1% (5%) [10%].

Source: Own computation base on primary data gathered from 48 startups.

Grouping companies into two categories, those that have PhDs collaborators and those that do not, we verified that informal and formal protection mechanisms are more used by companies that have at least one PhD collaborator. Applying Kruskal-Wallis test, we noticed that differences are only statistically significant (at the 1% of significance) for the use of informal protection mechanisms (see Figure 8).

Formal protection mechanisms, namely patents, trademarks and geographical indications are more used by companies that have at least one PhD collaborator, while industrial design and copyrights and rights related to copyright are more used by companies have not any PhD collaborator.

In respect to informal protection mechanisms, all of them are more used by companies that have at least one PhD collaborator.

Despite the differences observed, Kruskal-Wallis test demonstrates that these differences are only statistically significant at 10% of significance for the use of patents and at 1% for the use of trade secrets.

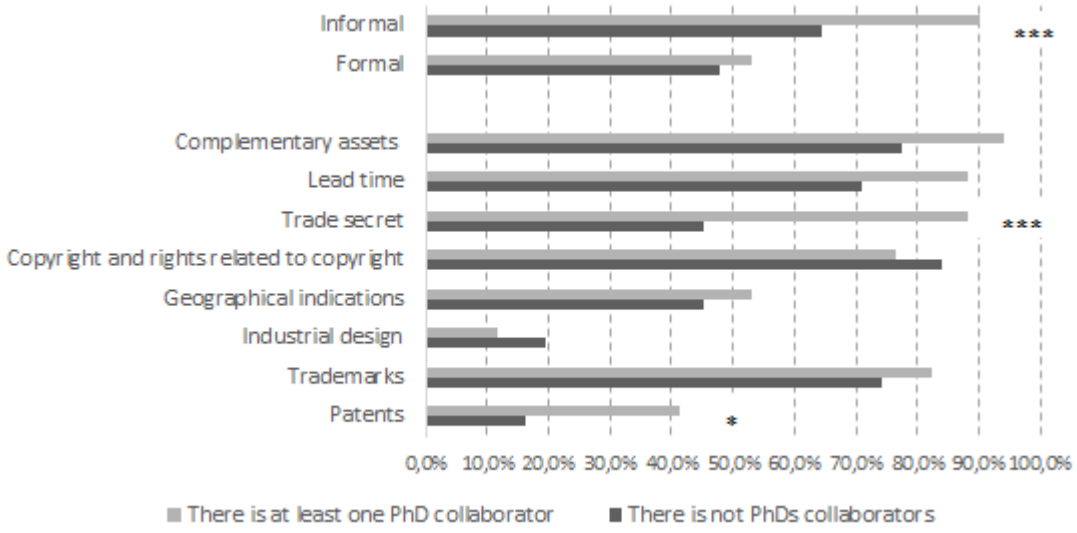


Figure 8: Average use of IPRs by companies considering the existence of PhDs collaborators

Note: *** (*): Statistically significant at 1% (10%).

Source: Own computation base on primary data gathered from 48 startups.

To check the differences on the average use of IPRs by sector, we grouped the companies into 4 categories: 'Computing and related', 'Architecture, Design and R&D activities', 'Retail and wholesale', and 'Other'.

According Table 5, informal protection mechanisms are more used by companies dedicated to 'Retail and wholesale' and 'Other' business activities, while formal protection mechanisms are more used only by companies dedicated to 'Other' business activities.

Within formal protection mechanisms, patents are more used by companies dedicated to 'Architecture, design and R&D activities' and 'Other' business activities, whereas trademarks and geographical indications are more used by companies dedicated to 'Computing and related' and 'Other' business activities. Industrial designs are more used by companies dedicated to 'Other' business activities, and copyrights and rights related to copyright are more used by companies dedicated to 'Computing and related' , 'Retail and wholesale' and 'Other' business activities.

Regarding to informal protection mechanisms, all of them are more used by companies dedicated to 'Retail and wholesale' and 'Other' business activities.

Despite the differences observed, Kruskal-Wallis test evidences that these differences are only statistically significant at the 10% of significance for the use of industrial design and at the 5% for the use of geographical indications.

Table 5: Average use of IPRs according to companies' sector

IPRs	Computing and related	Architecture, design and R&D activities	Retail/ Wholesale	Other	Kruskal-Wallis test (p-value)
Patents	21.1%	30.0%	16.7%	33.3%	0.863
Trademarks	84.2%	75.0%	50.0%	100.0%	0.273
Industrial design	**15.8%**	**15.0%**	**0.0%**	**66.7%**	**0.089***
Geographical indications	**31.6%**	**45.0%**	**83.3%**	**100.0%**	**0.042****
Copyrights and rights related to copyright	84.2%	75.0%	83.3%	100.0%	0.728
Trade secret	63.2%	55.0%	66.7%	66.7%	0.931
Lead time	68.4%	75.0%	100.0%	100.0%	0.326
Complementary assets	78.9%	80.0%	100.0%	100.0%	0.537
Formal	47.4%	48.0%	46.7%	80.0%	0.234
Informal	70.2%	70.0%	88.9%	88.9%	0.737

Note: ** (*): Statistically significant at 5% (10%).

We further analyse whether the differences on the average use of IPRs are dependent on companies' competitiveness, as measured by 3 indicators: average sales per capita, average Gross Value Added (GVA) per capita, and average Earnings Before Interest, Taxes, Depreciation and Amortization (EBITDA). In order to do that we considered the top 25% and top 50% more competitive companies.

In case of the average sales per capita, the top 25% more competitive companies are those which have an average sales per capita above 44.166,70 €, while the top 50% more competitive companies are those which have an average sales per capita above 22.991,90 €.

Considering the top 25% more competitive companies, we found that both formal and informal protection mechanisms are more used by least competitive companies, being such difference (according Kruskal-Wallis test) statistically significant at the 5% of significance for formal protection mechanisms and at 10% for informal protection mechanisms (see Figure 9).

We also uncovered that all protection mechanisms (formal and informal) are more used by least competitive companies. However, despite the differences observed, Kruskal-Wallis test evidences that these differences are only statistically significant, at the 10% of significance, for the use of trademarks, industrial design, lead time and complementary assets.

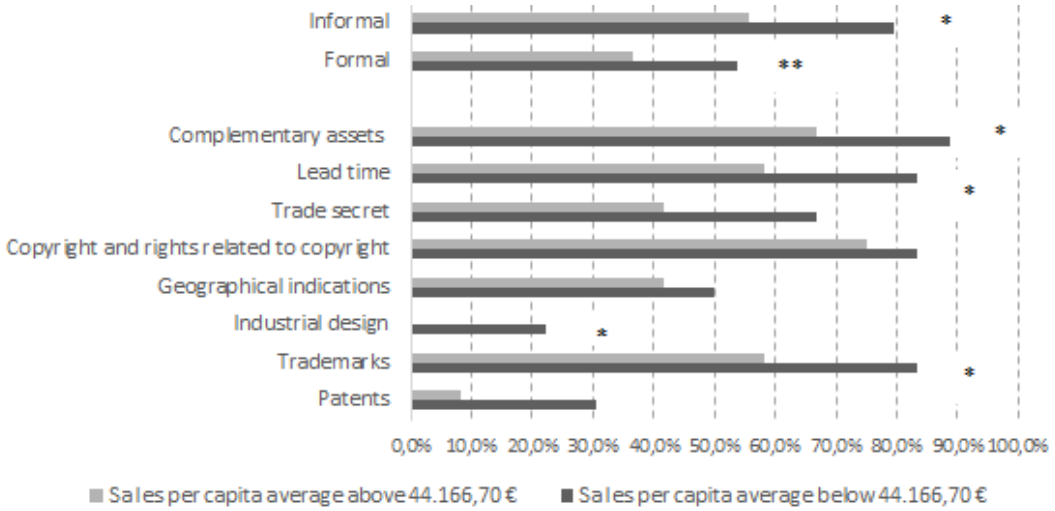


Figure 9: Average use of IPRs by companies considering top 25% more competitive companies according average sales per capita

Note: ** (*): Statistically significant at 5% (10%).

Source: Own computation base on primary data gathered from 48 startups.

Regarding the top 50% more competitive companies, we found that both formal and informal protection mechanisms are more used by least competitive companies, being such difference (according Kruskal-Wallis test) statistically significant at the 1% of significance for formal protection mechanisms and at 5% for informal protection mechanisms (see Figure 10).

We also found that all protection mechanisms (formal and informal) are more used by least competitive companies. However, despite the differences observed, Kruskal-Wallis test evidences that these differences are only statistically significant at the 10% of significance for the use of trademarks and copyrights and rights related to copyright, and, at 1%, for the use of patents, industrial design and trade secret.

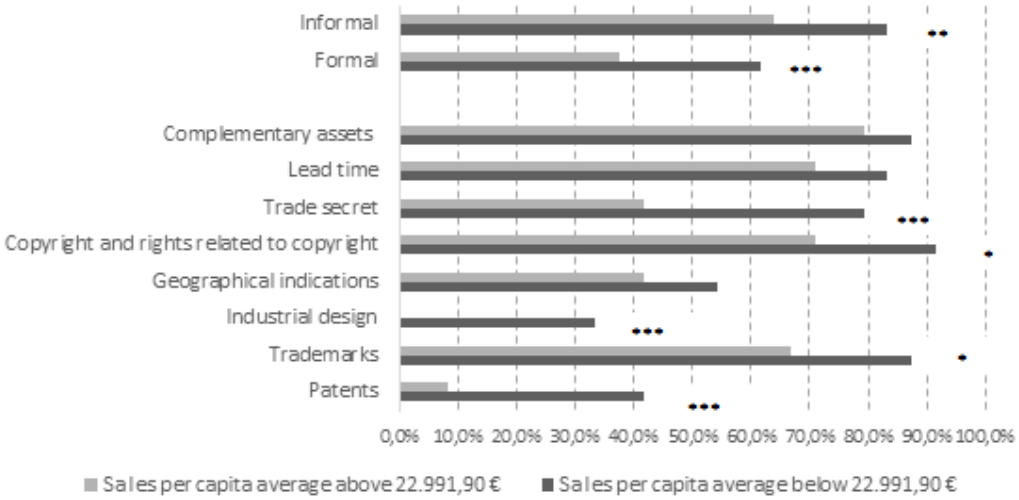


Figure 10: Average use of IPRs by companies considering top 50% more competitive companies according average sales per capita

Note: *** (**) [*]: Statistically significant at 1% (5%) [10%].

Source: Own computation base on primary data gathered from 48 startups.

In the case of the average GVA per capita, the top 25% more competitive companies are those with an average GVA per capita above 34.203,60 €, while the top 50% more competitive companies are those with that indicator above 7.525,20 €.

For both groups of companies, we found that both formal and informal protection mechanisms are more used by least competitive companies, being such difference (according Kruskal-Wallis test) only statistically significant at the 5% of significance for informal protection mechanisms (see Figure 11 e 12).

Considering the top 25% more competitive companies, formal protection mechanisms such as patents, geographical indicators and copyrights and rights related to copyright assume an average use equivalent among the most and least competitive companies. In turn, trademarks and industrial design are more used by least competitive companies.

In respect to informal protection mechanisms, all of them are more used by least competitive companies, being such differences (according Kruskal-Wallis test) statistically significant at the 10% of significance for the use of trade secret and at the 5% for the use of lead time and complementary assets.

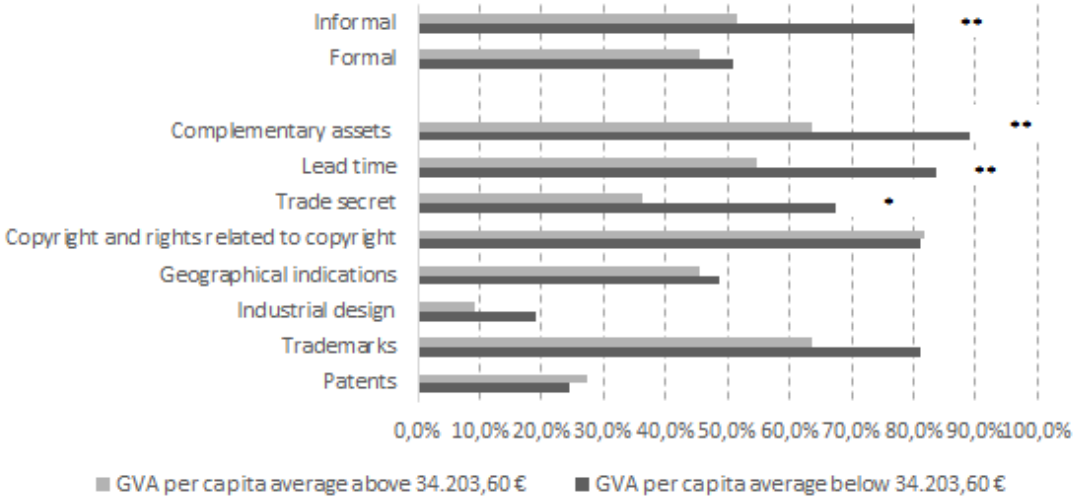


Figure 11: Average use of IPRs by companies considering top 25% more competitive companies according average GVA per capita

Note: ** (*): Statistically significant at 5% (10%).

Source: Own computation base on primary data gathered from 48 startups.

Taking into account the top 50% more competitive companies, we found that all protection mechanisms (formal and informal) are more used by least competitive companies, being such differences (according Kruskal-Wallis test) only statistically significant for the use of the informal protection mechanisms: at the 5% of significance for the use of trade secret and at the 10% for the use of lead time and complementary assets (see Figure 12).

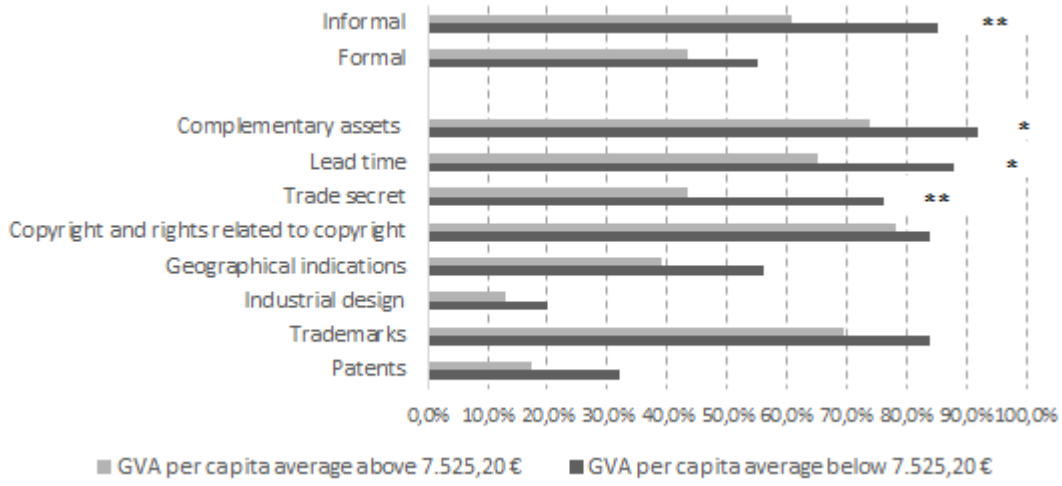


Figure 12: Average use of IPRs by companies considering 50% more competitive companies according average GVA per capita

Note: ** (*): Statistically significant at 5% (10%).

Source: Own computation base on primary data gathered from 48 startups.

In the case of average EBITDA, the top 25% more competitive companies are those which have an average EBITDA above 40.783,70 €, while the top 50% have a corresponding indicator of 6.427,70 €.

Considering the top 25% more competitive companies, we found that both formal and informal protection mechanisms are more used by least competitive companies (see Figure 13). We further uncover that all formal protection mechanisms are more used by least competitive companies, except geographical indications which assume an average use equivalent among the most and least competitive companies.

Applying Kruskal-Wallis test, we demonstrate that none of the differences observed are statistically significant.

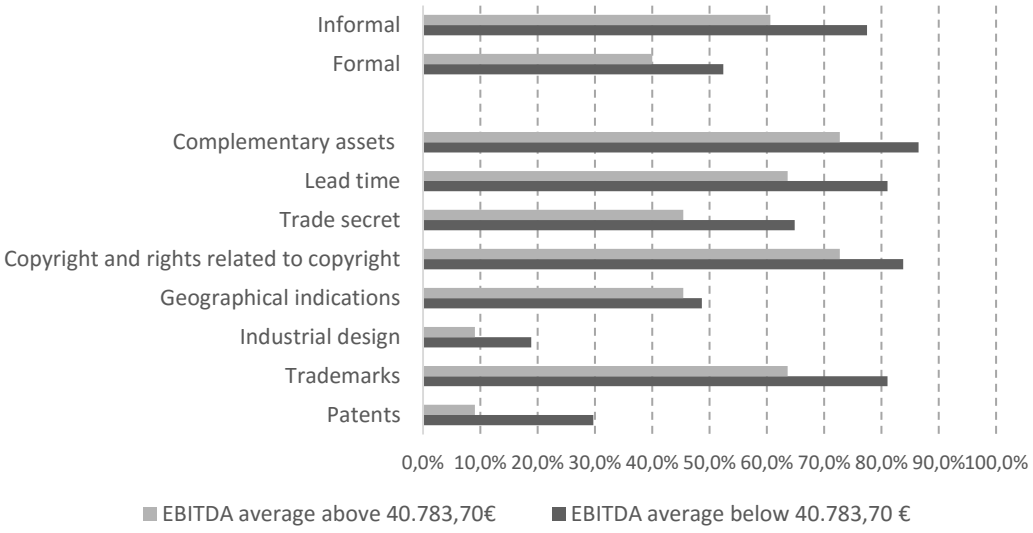


Figure 13: Average use of IPRs by companies considering 25% more competitive companies according average EBITDA indicator

Source: Own computation base on primary data gathered from 48 startups.

Considering the top 50% more competitive companies, we found that both formal and informal protection mechanisms are more used by least competitive companies, being such difference (according Kruskal-Wallis test) statistically significant at the 10% of significance both protection mechanisms (see Figure 14).

We also observe that all protection mechanisms (formal and informal) are more used by least competitive companies. However, despite the differences observed, Kruskal-Wallis test evidences that these differences are only statistically significant, at the 10% of significance, for the use of trademarks and, at the 5%, for the use of trade secret.

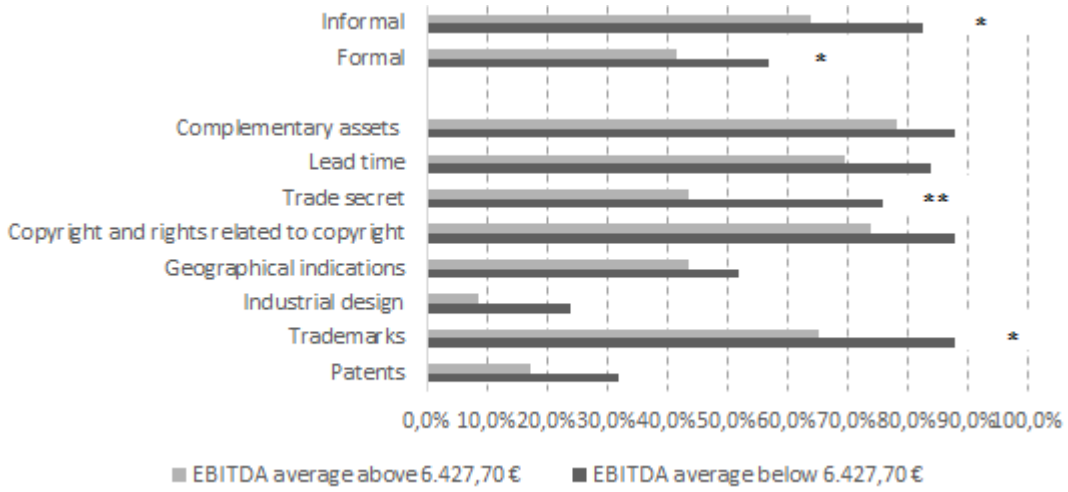


Figure 14: Average use of IPRs by companies considering top 50% more competitive companies according average EBITDA

Note: ** (*): Statistically significant at 5% (10%).

Source: Own computation base on primary data gathered from 48 startups.

To finalize our descriptive analysis we explored, in isolation, whether the IPRs strategy – formal, informal or blend - is associated with companies' competitiveness.

First, we tested whether there were differences on competitiveness indicators – average sales per capita, average GVA per capita, and average EBITDA - considering the simultaneous use of formal and informal protection mechanisms (i.e., blend strategy).

In order to do that we grouped the companies into 2 groups, considering whether they opted for a blend strategy or not: simultaneous use of formal and informal protection mechanisms and other (do not use any protection mechanism; uses formal/informal protection mechanismsin isolation).

We verified that, regardless of the competitiveness indicator considered, the strategy of not using any protection mechanism or using formal/informal protection mechanisms in isolation tends to be associated with higher competitiveness compared to the strategy of using simultaneously formal and informal protection mechanisms (see Figure 15). Nevertheless, Kruskal-Wallis test evidences that these differences are only statistically significant, at the 1% of significance, for average sales per capita and, at the 5%, for average GVA per capita.

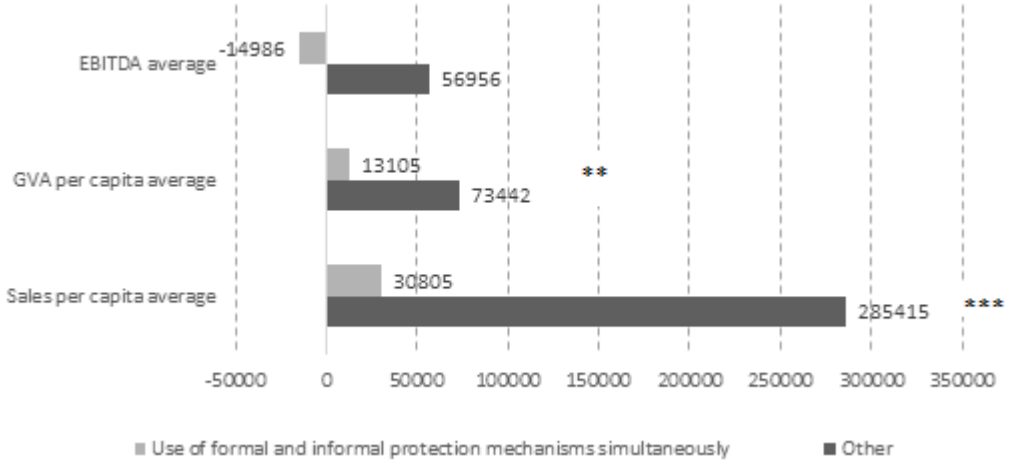


Figure 15: Differences on competitiveness indicators considering the use of formal and informal protection mechanisms simultaneously

Note: *** (**): Statistically significant at 1% (5%).

Source: Own computation base on primary data gathered from 48 startups.

Then, we went to check out whether there were differences on competitiveness indicators considering IPRs protection strategy, i.e., each of the above mentioned possibilities: do not use any protection mechanism, uses only informal protection mechanisms, uses only formal protection mechanisms and use of formal and informal protection mechanisms simultaneously.

More specifically, we verified that the companies that do not use any protection mechanism have a higher sales and GVA per capita compared to those that use some kind of protection, while those that use only formal protection mechanisms have a higher average EBITDA compared to those which opt for any of the other possibilities. Notwithstanding, Kruskal-Wallis test evidences that these differences are only statistically significant, at the 5% of significance, for the average sales per capita and the average GVA per capita (see Figure 16).

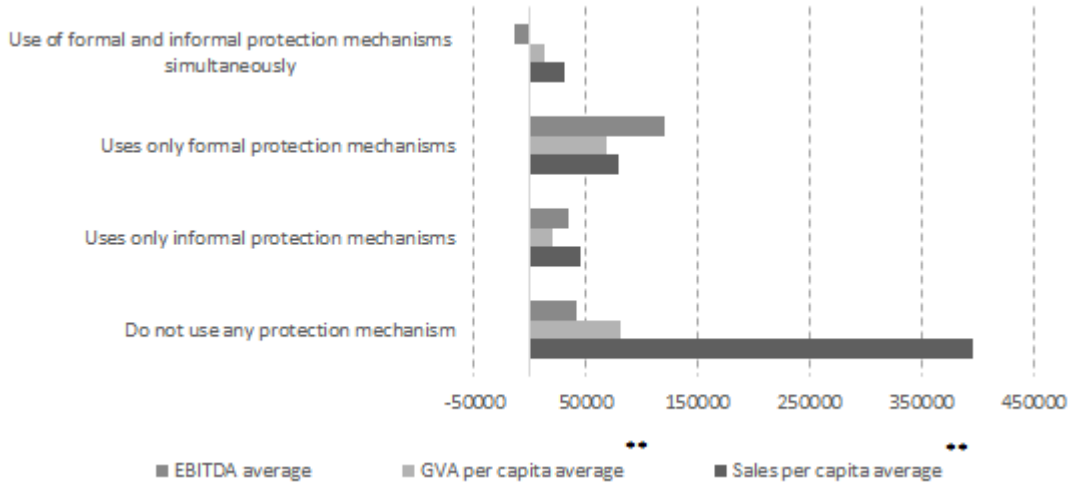


Figure 16: Differences on competitiveness indicators considering the IPRs protection strategy

Note: **: Statistically significant at 5%.

Source: Own computation base on primary data gathered from 48 startups.

Lastly, we analyse the purposes of the use of IPRs mechanisms considering the degree of importance attributed by respondent companies.

Companies mentioned that the main purpose when they protect their assets is to gain competitive advantage (4.146 score in a scale from 1 to 5). To enter into the international market, to exclusively use and commercialize a product or service and to attract investment are also important purposes that lead to IPRs protection by companies (importance of 3.750 on a scale from 1 to 5) (see Figure 17).

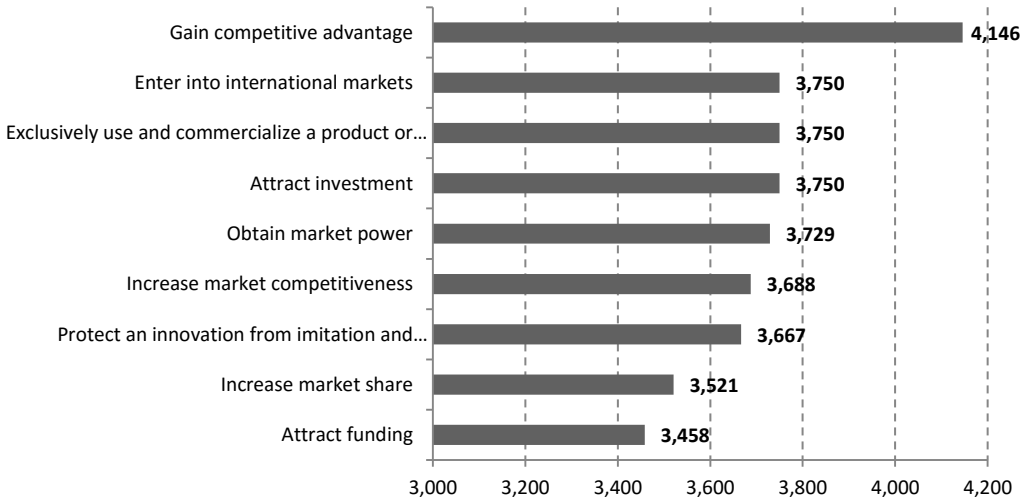


Figure 17: Degree of importance (1: low…5: high) attributed to the given purposes of the use of IPRs mechanisms

Source: Own computation base on primary data gathered from 48 startups.

Considering the competitiveness indicators, we checked whether there were differences in companies' competitiveness according to the degree of importance attributed by respondent companies to the main purposes of the use of IPRs mechanisms.

The top 25% performers by sales and GVA (see Table 6) attributed less importance, compared with the less competitive companies, to the purposes such as attracting funding, attracting investment, to obtain market power, to gain competitive advantage, to increase market share and to enter into international markets. Notwithstanding, Kruskal-Wallis test evidences that these differences are only statiscally significant (at the 5% of significance) for the purpose of to attract funding.

The top 50% performers by sales, compared to the remaining companies, attributed less importance to the purposes such as attract funding, attract investment, obtain market power, gain competitive advantage, protect an innovation from imitation and exploitation by competitors, increase market share and enter into international markets and a higher importance to the remaining purposes. Kruskal-Wallis test evidences, however, shows that these differences are only statiscally significant (at 10% of significance) for the purpose of attracting funding and of attracting investment (at 5%).

Compared with the non-top 50% performers, the top 50% performers in terms of average GVA per capita attributed less importance to attract funding, attract investment, obtain market power, increase market share and enter into international markets and attributed higher importance to the remaining purposes.

Regarding average EBITDA top (25% and 50%) performers attributed less importance to attract funding, attract investment, obtain market power, and enter into international markets and a higher importance to the remaining. Despite the differences observed, applying Kruskal-Wallis we demonstrate that none of the differences observed are statistically significant for the last 3 indicators.

Table 6: Main purposes of the use of IPRs mechanisms: degree of importance (1: low …5: high) attributed by respondent companies

	Sales per capita (top25%)		Sales per capita (top50%)		GVA per capita (top25%)		GVA per capita (top50%)		EBITDA (top25%)		EBITDA (top50%)	
	Non top perf	**Top perf**	**Non top perf**	**Top perf**	**Non top perf**	**Top perf**	**Non top perf**	**Top perf**	**Non top perf**	**Top perf**	**Non top perf**	**Top perf**
Attract funding	3.722	2.667**	3.833	3.083*	3.676	2.727**	3.760	3.130	3.568	3.091	3.640	3.261
Attract investment	3.917	3.250	4.167	3.333**	3.811	3.545	3.840	3.652	3.757	3.727	3.840	3.652
Obtain market power	3.861	3.333	3.833	3.625	3.784	3.545	3.880	3.565	3.784	3.545	3.760	3.696
Exclusively use and commercialize a product or service	3.722	3.833	3.708	3.792	3.649	4.091	3.680	3.826	3.676	4.000	3.520	4.000
Gain competitive advantage	4.194	4.000	4.292	4.000	4.162	4.091	4.040	4.261	4.108	4.273	4.120	4.174
Protect an innovation from imitation and exploitation by competitors	3.639	3.750	3.708	3.625	3.595	3.909	3.600	3.739	3.622	3.818	3.600	3.739
Increase market competitiveness	3.667	3.750	3.667	3.708	3.676	3.727	3.640	3.739	3.622	3.909	3.680	3.696
Increase market share	3.583	3.333	3.583	3.458	3.622	3.182	3.600	3.435	3.514	3.545	3.520	3.522
Enter into international markets	3.861	3.417	3.917	3.583	3.838	3.455	3.840	3.652	3.757	3.727	3.840	3.652

Note: ***(**)[*]: differences between non-top performers and top performers (Kruskal Wallis test) statistically significant at 1%(5%)[10%].

4.2. Causality analysis: does IPRs protection matter for companies' competitiveness?

The estimation of the econometric model was carried out resorting to logistic regressions that aimed, in a multivariate setting, to assess the impact of IPRs protection mechanisms on the competitiveness of the 48 startups located in four science and technology parks over the period 2013-2015.

Given that there are some high correlations between independent variables, namely lead time and complementary assets, the estimated models included these variables separately to avoid multicollinearity issues. According to the conceptual model (see Figure 1), the specifications were estimated with and without the interaction variables.

Table 7 presents a selection of the estimated econometric specifications.[11] The indicators of the goodness of fit evidence that all models are adequate: both the R^2 and the percentage of observations estimated correctly are very high; moreover, excluding the Model 2B, the Hosmer and Lemshow test indicates that the remaining models represent the reality well.

Estimation results demonstrate that, in general, IPRs protection is not positively related to the companies' competitiveness, at least directly, which contradicts our Hypothesis 1 (*Companies that protect their assets are more competitive*). Indeed, when the estimated coefficient is statistically significant (Model 1C, in Table 7), the use of formal protection mechanisms impacts negatively on companies' competitiveness. Additionally, informal IPR mechanisms indirectly (through R&D) negatively impact on companies' competitivess.

When we discriminate the IPRs protection mechanisms by type used by companies we got quite varied results. In general, we found that the use of informal protection mechanisms, most notably, trade secrets and lead time, foster companies' competitiveness, whereas the use of formal protection mechanisms, in particular, patents, trademarks and geographical indications, negatively impact that same competitiveness (see Table 7, Models 2B and 2D).

These results support Hypotheses 2, *The type of IPRs strategy - formal vs. informal - influences the competitiveness of the companies*.

[11] Tables A1 to A6 in the Appendix present the full estimations for the top 25% and 50% more competitive companies according to the three competitiveness indicators considered.

In relation to the interaction variables, estimation results convey that the impact on companies' competitivess of informal protection mechanisms is higher the smaller is the company's size.[12] Regarding the formal protection mechanisms (see Table 7, Models 2B), their impact on companies' competitiveness is stronger the larger is the company. Such results corroborate Hypothesis 3, *The size of the company intermediates the influence of IPRs protection on the competitiveness of that same company.*

Lastly, informal protection mechanisms tend to increase the companies' competitivess the least intensive in R&D is the company (see Models 1B and 1C, in Table 7). In contrast, the higher is the R&D intensity of a company, the stronger is the positive impact of formal protection mechanisms on companies' competitiveness (see Models 1B, 2B and 2D, in Table 7). This confirms Hypothesis 4, *The innovation profile of the company intermediates the influence of IPRs protection on the competitiveness of that same company.*

[12] Considering the top 50% most competitive companies according to the average GVA per capita, we obtained the opposite result, although at the limit of the statistical significance (p-value = 0,093) (see Table 7, Model 1B).

Table 7: Preferable models by indicator for the causality analysis: Does IPRs protection matter for companies' competitiveness?

			Salespc25		Salespc50		GVApc25		GVApc50		EBITDA25		EBITDA50	
			Model 2B		Model 1C		Model 1B		Model 1B		Model 2B		Model 2D	
			beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*
IPR use	**Informal IPRs** (average importance of the IPR in ln)	Trade secret (dummy=1 if the firm uses this IPR; 0 otherwise)	7.271	*0.051*							4.734	*0.074*	-2.978	*0,051*
		Lead time (dummy=1 if the firm uses this IPR; 0 otherwise)	15.393	*0.040*	-0.446	*0.809*	-0.078	*0.968*	-2.385	*0.151*	12.524	*0.024*	2.061	*0,161*
		Complementary assets (dummy=1 if the firm uses this IPR; 0 otherwise)												
	Formal IPRs (average importance of the IPR in ln)	Patents (dummy=1 if the firm uses this IPR; 0 otherwise)	-14.794	*0.088*							-21.313	*0.019*	-3.062	*0,083*
		Trademarks (dummy=1 if the firm uses this IPR; 0 otherwise)	-5.810	*0.078*							-7.019	*0.029*	-2.860	*0,053*
		Industrial design (dummy=1 if the firm uses this IPR; 0 otherwise)	-35.400	*0.995*	-4.438	*0.054*	0.668	*0.807*	0.330	*0.899*	-14.893	*0.034*	1.004	*0,659*
		Geographical indications (dummy=1 if the firm uses this IPR; 0 otherwise)	-11.249	*0.021*							-0.859	*0.638*	0.425	*0,750*
		Copyrights and rights related to copyright (dummy=1 if the firm uses this IPR; 0 otherwise)	-12.932	*0.060*							-12.698	*0.019*	-0.690	*0,588*
	Interaction between IPRs type and Size/type of innovation	Informal*size	-12.440	*0.052*	1.462	*0.366*	-2.128	*0.430*	2.978	*0.093*	-9.479	*0.029*		
		Informal*ID	-13.705	*0.211*	-7.354	*0.087*	-33.477	*0.086*	-11.198	*0.069*	-12.493	*0.116*		
		Formal*size	34.070	*0.031*			1.211	*0.745*	-3.671	*0.112*	15.829	*0.021*	-1.171	*0,605*
		Formal*ID	-28.103	*0.105*			48.278	*0.052*	16.298	*0.052*	63.808	*0.036*	8.675	*0,071*
Control variables	**Companies' characteristics**	Age (ln)	-0.042	*0.988*	2.716	*0.033*	2.325	*0.176*	1.706	*0.107*	-0.920	*0.591*	0.754	*0,491*
		Size (ln)	-2.870	*0.432*	-1.106	*0.347*	0.060	*0.963*	-0.488	*0.663*	2.392	*0.154*	0.740	*0,533*
		Human capital (dummy=1 if the firm employs at least one PhD; 0 otherwise)	-3.281	*0.248*	-0.482	*0.688*	1.820	*0.425*	-0.868	*0.417*	-3.507	*0.071*	2.259	*0,195*
		R&D intensity (dummy=1 if the firm has a R&D intensity above 50%)	-1.169	*0.884*	1.880	*0.466*	-10.645	*0.143*	-1.756	*0.383*	-24.027	*0.031*	-4.717	*0,052*
	Context	Sector (dummy=1 if the companies operates in Computing sector; 0 otherwise)	-4.025	*0.115*	-2.602	*0.028*	0.806	*0.640*	0.966	*0.349*	-0.404	*0.795*	-0.905	*0,449*
		Region (dummy=1 if the firm is located in UPTEC; 0 otherwise)	2.759	*0.185*	0.938	*0.416*	-2.773	*0.083*	-0.565	*0.515*	-0.335	*0.821*	2.308	*0,055*
		N	48		48		48		48		48		48	
		Top competitiveness companies	12		24		12		23		11		23	
		Other	36		24		36		25		37		25	
Godness of fit		Adjusted R2	0.790		0.667		0.612		0.442		0.559		0.434	
		Hosmer and Lameshow Test (p-value)	33.851	*0.000*	5.104	*0.746*	4.729	*0.786*	11.377	*0,187*	2,789	*0,947*	7,283	*0,506*
		% correct	97.9		87.5		85.4		72.9		85.4		72.9	

5. Conclusions

5.1. Main results and contribution for scientific knowledge

The analysis of the purposes of the use of IPRs mechanisms by respondent companies revealed that they protect their assets mainly to gain competitive advantage, as sustained by the most recent literature (see Singh, 2015). Validating other previous studies (e.g., Glass and Saggi, 2002; Smarzynska, 2004), companies reported that the attraction of investment was also an essential purpose that led them to IPRs protection. Equally important for Academic Spin-offs to undertake IPR protection was the purposes of entering into the international market and to exclusively use and commercialize a product or service. Additionally, we found that the most competitive companies are those that attribute lower importance to attract funding and to attract investment and a higher importance to obtain market power, exclusively use and commercialize a product or service, gain competitive advantage, protect an innovation from imitation and exploitation by competitors, increase market competitiveness, increase market share, and enter into international markets. This suggests that the most competitive Academic Spin-offs (ASOs) effectively recognize the importance of IPRs protection to gain competitive advantage and not just for accessing or grant additional financial sources.

Regardless the type of IPRs protection mechanisms (formal or informal), the companies that use them justify their use by the effectiveness they bare in terms of protection, particularly in the case of patents – as expected for small companies that invest heavily in R&D (Thomä and Bizer, 2013) such as ASOs - and trademarks (Singh, 2015), but also in the case of geographical indications. We further found that the simplicity in the utilization and implementation is particularly important for companies that use industrial designs, being low cost the least important reason for deciding to protect their IPRs.

The results of the present study established that, in general, the most competitive companies are those that use less formal IPRs protection. Moreover, when we discriminate the IPRs protection mechanisms by type we found that the use of informal protection mechanisms, most notably, lead time and trade secrets, foster companies' competitiveness whereas the use of formal protection mechanisms, in particular, patents, trademarks and geographical indications, negatively impacts that same competitiveness. Such results seem at odds with extant literature that highlight the

importance of formal IPRs protection mechanisms, especially in small businesses (Chaudhuri, Goldberg and Jia, 2003; WIPO, 2006), and its extensive use throughout the industrial history to obtain competitive advantage (Singh, 2015). Thus, in line with Sey et al. (2010), the most competitive Academic Spin-offs inquired tend to use informal instead of formal IPRs protection mechanisms. Summing up, the type of IPRs strategy influences companies' competitiveness.

We further uncovered that the impact on companies' competitiveness of informal protection mechanisms is higher the smaller is the company's size. This finding confirms what other authors (e.g., Thomä and Bizer, 2013) had already mentioned: the use of informal protection mechanisms by small companies is more profitable in terms of the appropriation of innovations returns. In contrast, the impact of formal protection mechanisms on companies' competitiveness is stronger the larger is the company. Similarly, and in line with Thomä and Bizer's (2013) contribution, the higher the R&D commitment to achieve the returns of innovation, the stronger is the impact of formal protection mechanisms on ASOs' competitivess. Hence, the use of formal protection mechanisms seems to be an added value to the highly R&D intensive companies. In a divergent fashion, results suggested the impact of informal protection mechanisms is higher for the least R&D intensive companies. This latter evidence seems to go in line with studies (e.g., Baldwin and Gellatly, 2003; Mazzarol and Reboud, 2009) that show that small companies are less R&D intensive and, therefore, opt by more informal protection mechanisms.

5.2. Limitations and avenues for future research

This research study has some limitations that may constitute avenues for further and future research. The most obvious is related with the reduced number of responses and the focus on a unique type of companies, the ASOs. Although the sample is representative of the population, it would be illuminating to include in the analysis not only ASOs but other type of startups companies.

Additionally, the competitiveness was assessed over a very small period of time (three years). The consideration of a longitudinal analysis, involving a longer period of time, and resorting to panel data techniques would certainly enrich the analysis.

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Appendix

A1 – Questionnaire

Inquérito

O presente inquérito foi desenvolvido no âmbito da tese de mestrado em Inovação e Empreendedorismo Tecnológico subordinada ao tema 'Intellectual property rights protection as source of competitive advantage'.

O propósito deste trabalho de investigação é o de aferir o impacto da proteção dos direitos de propriedade intelectual na competitividade de startups inseridas em parques de ciência e tecnologia e incubadoras. Assim, este inquérito tem como principal objetivo a recolha de informação relativa a características descritivas da empresa, à utilização e importância, para a empresa, dos tipos de proteção de ativos, às principais razões para a utilização desses meios de proteção e à finalidade de utilização dos mesmos e aos indicadores relacionados com a competitividade da empresa.

As informações recolhidas serão apenas utilizadas para os fins de investigação supramencionados, sendo garantida a total confidencialidade e anonimato das mesmas.

Dado não existir informação publicamente disponível sobre este assunto, o presente inquérito é essencial para a realização do meu projeto de investigação, pelo que desde já agradeço a atenção disponibilizada.

NEXT

11% complete

Descrição da Empresa

Designação da empresa *

Your answer

CAE (a 5 dígitos) *

Para consulta do CAE (Código de Atividade Económica) da empresa pode utilizar o seguinte link: http://www.sicae.pt/Consulta.aspx

Your answer

Ano de constituição *

- ○ 2006 (10 anos)
- ○ 2007 (9 anos)
- ○ 2008 (8 anos)
- ○ 2009 (7 anos)
- ○ 2010 (6 anos)
- ○ 2011 (5 anos)
- ○ 2012 (4 anos)
- ○ 2013 (3 anos)
- ○ Other : _____

Número de pessoas ao serviço *

Your answer

Número de pessoas ao serviço em equivalente a tempo integral (ETI) *

Equivalente a tempo integral (ETI) é a unidade para medir o tempo que o pessoal dedica a actividades da empresa em cada ano. Por exemplo, uma entidade que contrata 10 pessoas durante meio ano reporta apenas 5 ETI. Outro exemplo, 5 pessoas que dedicam 20% do seu tempo representam 1 ETI.

Your answer

BACK NEXT 22% complete

Utilização e importância, para a empresa, dos seguintes meios de proteção de ativos

Se não usar, por favor indique 0 (zero).

Patentes *

Uma patente é uma concessão pública, conferida pelo Estado, que garante ao seu titular a exclusividade de explorar comercialmente a sua criação. Em contrapartida, o titular da patente disponibiliza acesso ao público sobre o conhecimento dos pontos essenciais e as reivindicações que caracterizam a novidade da invenção.

	0	1	2	3	4	5	
Nada importante	○	○	○	○	○	○	Muito importante

Marcas registadas *

Uma marca registada é qualquer nome ou símbolo (e.g., logótipos) utilizado para identificar uma empresa, um produto ou um serviço.

	0	1	2	3	4	5	
Nada importante	○	○	○	○	○	○	Muito importante

Desenho industrial *

O registo de desenho industrial protege a configuração externa de um objeto tridimensional ou um padrão ornamental (bidimensional) que pode ser aplicado a uma superfície ou a um objeto. Por outras palavras, ele protege a aparência que diferencia um produto dos demais.

	0	1	2	3	4	5	
Nada importante	○	○	○	○	○	○	Muito importante

Segredo comercial *

Um segredo comercial é uma fórmula, prática, processo, design, instrumento, padrão ou uma compilação de informações usadas por um negócio para obter uma vantagem sobre a concorrência ou sobre os consumidores.

	0	1	2	3	4	5	
Nada importante	○	○	○	○	○	○	Muito importante

Denominação de origem *

A denominação de origem refere-se ao nome de uma região, de um local ou, em casos excecionais, de um país, que serve para designar ou identificar um produto.

	0	1	2	3	4	5	
Nada importante	○	○	○	○	○	○	Muito importante

Direitos de autor e direitos relacionados com direitos de autor *

Direitos de autor são os direitos dos autores sobre as suas obras intelectuais, sejam estas literárias, artísticas ou científicas.

	0	1	2	3	4	5	
Nada importante	○	○	○	○	○	○	Muito importante

Tempo de aprovisionamento ou ciclo ("lead time") *

O tempo de aprovisionamento ou ciclo ("lead time"), é o período de tempo entre o início de uma atividade, produtiva ou não, e o seu término.

	0	1	2	3	4	5	
Nada importante	○	○	○	○	○	○	Muito importante

	0	1	2	3	4	5	
Nada importante	○	○	○	○	○	○	Muito importante

Ativos complementares ("complementary assets") *

Ativos complementares são ativos, infra-estruturas ou recursos utilizados para apoiar a comercialização bem sucedida de uma inovação tecnológica que vão para além dos activos fundamentalmente associados a essa inovação (e.g., estratégias de marketing, assistência pós-venda, formação sobre a utilização de um produto ou serviço).

	0	1	2	3	4	5	
Nada importante	○	○	○	○	○	○	Muito importante

BACK NEXT

33% complete

Principais razões para a utilização dos meios de proteção de ativos

Patentes *

- [ ] Não utilizo
- [ ] Simplicidade na utilização e implementação
- [ ] Baixo custo
- [ ] Eficácia em termos de proteção
- [ ] Other: _____

Marcas registadas *

- [ ] Não utilizo
- [ ] Simplicidade na utilização e implementação
- [ ] Baixo custo
- [ ] Eficácia em termos de proteção
- [ ] Other: _____

Desenho industrial *

- [ ] Não utilizo
- [ ] Simplicidade na utilização e implementação
- [ ] Baixo custo
- [ ] Eficácia em termos de proteção
- [ ] Other: _____

Segredo comercial *

- [ ] Não utilizo
- [ ] Simplicidade na utilização e implementação
- [ ] Baixo custo
- [ ] Eficácia em termos de proteção
- [ ] Other: _____

Denominação de origem *

- [ ] Não utilizo
- [ ] Simplicidade na utilização e implementação
- [ ] Baixo custo
- [ ] Eficácia em termos de proteção
- [ ] Other: _____

Direitos de autor e direitos relacionados com direitos de autor *

- [ ] Não utilizo
- [ ] Simplicidade na utilização e implementação
- [ ] Baixo custo
- [ ] Eficácia em termos de proteção
- [ ] Other: _____

Tempo de aprovisionamento ou ciclo ("lead time") *

- [ ] Não utilizo
- [ ] Simplicidade na utilização e implementação
- [ ] Baixo custo
- [ ] Eficácia em termos de proteção
- [ ] Other: _____

Ativos complementares ("complementary assets") *

- [ ] Não utilizo
- [ ] Simplicidade na utilização e implementação
- [ ] Baixo custo
- [ ] Eficácia em termos de proteção
- [ ] Other: _____

BACK NEXT 44% complete

Finalidades da utilização destes meios de proteção de ativos

Atrair financiamento *

	1	2	3	4	5	
Nada importante	○	○	○	○	○	Muito importante

Atrair investimento *

	1	2	3	4	5	
Nada importante	○	○	○	○	○	Muito importante

Obter poder de mercado *

	1	2	3	4	5	
Nada importante	○	○	○	○	○	Muito importante

Usar e comercializar de forma exclusiva um produto ou serviço *

	1	2	3	4	5	
Nada importante	○	○	○	○	○	Muito importante

Obter vantagem competitiva *

	1	2	3	4	5	
Nada importante	○	○	○	○	○	Muito importante

Proteger uma inovação da imitação e exploração pelos concorrentes *

	1	2	3	4	5	
Nada importante	○	○	○	○	○	Muito importante

Aumentar a competitividade de mercado *

	1	2	3	4	5	
Nada importante	○	○	○	○	○	Muito importante

Aumentar a quota de mercado *

	1	2	3	4	5	
Nada importante	○	○	○	○	○	Muito importante

Entrar no mercado internacional *

	1	2	3	4	5	
Nada importante	○	○	○	○	○	Muito importante

Outras

Your answer

BACK NEXT

55% complete

Outros indicadores da empresa: volume de negócios/vendas (em €)

Em 2013 *

Your answer

Em 2014 *

Your answer

Em 2015 *

Your answer

Outros indicadores da empresa: valor acrescentado bruto (em €)

Em 2013 *

Your answer

Em 2014 *

Your answer

Em 2015 *

Your answer

BACK NEXT 77% complete

Outros indicadores da empresa: valor dos Lucros Antes de Juros, Impostos, Depreciação e Amortização - LAJIDA - (em €)

O LAJIDA corresponde ao EBITDA (em inglês), que é a sigla de "Earnings Before Interest, Taxes, Depreciation and Amortization".

Em 2013 *

Your answer

Em 2014 *

Your answer

Em 2015 *

Your answer

BACK NEXT 88% complete

Outros indicadores da empresa

Intensidade do I&D *

Percentagem do valor das atividades de Investigação e Desenvolvimento no volume de negócios da empresa.

Your answer

Percentagem de colaboradores doutorados no total das pessoas ao serviço *

Your answer

BACK SUBMIT 100%: You made it.

Muito obrigada pela sua valiosa colaboração!

A2 – Email letter to target companies

Pedido de colaboração (+/-5 minutos)

Cátia Ferreira <lc10061@gmail.com> 28/04

para Bcc:portugal, Bcc:amatteroftrust, Bcc:Geral, Bcc:contacto, Bcc:CREA, Bcc:depa, Bcc:douroskincare, Bcc:geral, Bcc:info, Bcc:info, Bcc:Melus, Bcc:info, Bcc:info, Bcc:info, Bcc:geral, Bcc:info, Bcc:welcome,

Boa tarde Exmos Senhores,

O meu nome é Cátia Ferreira. Sou aluna do Mestrado em Inovação e Empreendedorismo Tecnológico na Faculdade de Engenharia da Universidade do Porto.

No âmbito da minha tese de mestrado estou a desenvolver um trabalho de investigação cujo objetivo principal é o de aferir o impacto da proteção dos direitos de propriedade intelectual na competitividade de startups inseridas em parques de ciência e tecnologia e incubadoras.

Por inexistência de informação publicamente disponível sobre o assunto em questão, venho por este meio solicitar-vos o preenchimento do inquérito cujo link remeto:

https://docs.google.com/forms/d/1duIJM1-uIp2I8ctAYx_c13R1lvPvoCF5OEi_RR-Lwoc/viewform

O presente inquérito é essencial para a realização do meu projeto, pelo que desde já agradeço a atenção disponibilizada. Pf não ignorem o meu pedido.

Na expectativa de resposta vossa,

Subscrevo-me com os melhores cumprimentos,

Cátia Ferreira

Table A 1: Determinants of companies' competitiveness (dependent variable: top 25% more competitive companies according to average sales per capita)

			Model 1A		Model 1B		Model 1C		Model 1D		Model 2A		Model 2B		Model 2C		Model 2D		Model 2A		Model 2B		Model 2C		Model 2D	
			beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*
IPR use	**Informal IPRs** (average importance of the IPR in ln)	Trade secret (dummy=1 if the firm uses this IPR; 0 otherwise)	-0,853	*0,260*	*1,492*	*0,401*	0,995	*0,445*	-1,030	*0,201*	0,461	*0,662*	*7,271*	*0,051*	*2,178*	*0,189*	0,415	*0,709*	0,683	*0,541*	3,345	0,220	1,819	0,230	0,965	0,450
		Lead time (dummy=1 if the firm uses this IPR; 0 otherwise)									-0,952	*0,437*	*15,393*	*0,040*	*1,131*	*0,554*	-0,675	*0,614*								
		Complementary assets (dummy=1 if the firm uses this IPR; 0 otherwise)																	-1,568	*0,259*	0,740	0,795	-0,305	0,862	-2,464	0,166
	Formal IPRs (average importance of the IPR in ln)	Patents (dummy=1 if the firm uses this IPR; 0 otherwise)	-0,558	*0,588*	*-1,038*	*0,682*	-0,835	*0,496*	1,154	*0,545*	-1,141	*0,444*	*-14,794*	*0,088*	*-1,142*	*0,513*	-2,305	*0,312*	-1,075	*0,476*	*-3,697*	*0,224*	*-0,796*	*0,627*	-1,515	*0,533*
		Trademarks (dummy=1 if the firm uses this IPR; 0 otherwise)									-1,934	*0,098*	*-5,810*	*0,078*	*-1,379*	*0,292*	-3,103	*0,095*	-1,882	*0,122*	*-3,907*	*0,108*	*-1,543*	*0,229*	-2,913	*0,155*
		Industrial design (dummy=1 if the firm uses this IPR; 0 otherwise)									-20,468	*0,999*	####	*0,995*	####	*0,999*	-24,484	*0,998*	-20,604	*0,999*	*-31,303*	*0,997*	####	*0,999*	-25,428	*0,998*
		Geographical indications (dummy=1 if the firm uses this IPR; 0 otherwise)									0,270	*0,811*	*-11,249*	*0,021*	*-0,014*	*0,992*	-1,662	*0,339*	0,631	*0,606*	*-3,012*	*0,224*	*0,294*	*0,838*	-0,930	*0,623*
		Copyrights and rights related to copyright (dummy=1 if the firm uses this IPR; 0 otherwise)									1,244	*0,314*	*-12,932*	*0,060*	*0,545*	*0,694*	0,207	*0,916*	1,137	*0,367*	*-2,183*	*0,432*	*0,748*	*0,580*	0,235	*0,915*
	Interaction between IPRs type and Size/type of innovation	Informal*size			*-2,190*	*0,216*	-1,261	*0,304*					*-12,440*	*0,052*	*-1,651*	*0,295*					*-3,271*	*0,315*	*-0,908*	*0,494*		
		Informal*ID			*-2,519*	*0,537*	-3,862	*0,246*					*-13,705*	*0,211*	*-4,569*	*0,397*					*-2,583*	*0,656*	*-3,774*	*0,449*		
		Formal*size			*3,272*	*0,264*			0,776	*0,686*			*34,070*	*0,031*			6,106	*0,117*			*13,833*	*0,155*			6,633	*0,147*
		Formal*ID			*-14,483*	*0,050*			-14,014	*0,031*			*-28,103*	*0,105*			-9,758	*0,194*			*-10,091*	*0,310*			-12,512	*0,126*
Control variables	**Companies' characteristics**	Age (ln)	1,489	*0,123*	*1,742*	*0,148*	1,827	*0,083*	1,301	*0,220*	2,381	*0,095*	*-0,042*	*0,988*	*2,924*	*0,076*	1,935	*0,269*	2,776	*0,078*	*1,365*	*0,534*	*2,951*	*0,073*	2,515	*0,191*
		Size (ln)	0,292	*0,553*	*0,858*	*0,431*	0,948	*0,290*	0,588	*0,513*	0,785	*0,240*	*-2,870*	*0,432*	*1,784*	*0,166*	-0,926	*0,572*	0,946	*0,128*	*-2,455*	*0,357*	*1,211*	*0,207*	-0,952	*0,614*
		Human capital (dummy=1 if the firm employs at least one PhD; 0 otherwise)	-0,203	*0,849*	*-0,546*	*0,704*	-0,254	*0,828*	-0,013	*0,991*	-1,132	*0,418*	*-3,281*	*0,248*	*-1,476*	*0,333*	-1,207	*0,410*	-1,134	*0,419*	*-1,956*	*0,324*	*-1,379*	*0,358*	-1,420	*0,351*
		R&D intensity (dummy=1 if the firm has a R&D intensity above 50%)	-1,146	*0,291*	*3,240*	*0,264*	1,381	*0,552*	2,651	*0,197*	-0,406	*0,753*	*-1,169*	*0,884*	*2,547*	*0,522*	0,856	*0,759*	-0,713	*0,577*	*0,940*	*0,819*	*2,091*	*0,575*	1,432	*0,641*
	Context	Sector (dummy=1 if the companies operates in Computing sector; 0 otherwise)	-1,466	*0,191*	*-1,255*	*0,304*	-0,965	*0,405*	-1,461	*0,199*	-2,286	*0,115*	*-4,025*	*0,115*	*-2,036*	*0,202*	-2,841	*0,047*	-2,328	*0,111*	*-3,030*	*0,123*	*-1,979*	*0,204*	-3,102	*0,043*
		Region (dummy=1 if the firm is located in UPTEC; 0 otherwise)	0,624	*0,485*	*0,716*	*0,567*	0,525	*0,579*	0,235	*0,825*	1,006	*0,301*	*2,759*	*0,185*	*0,621*	*0,537*	1,195	*0,291*	0,970	*0,317*	*0,760*	*0,520*	*0,652*	*0,515*	0,835	*0,464*
N			48		48		48		48		48		48		48		48		48		48		48		48	
Top competitiveness companies			12		12		12		12		12		12		12		12		12		12		12		12	
Other			36		36		36		36		36		36		36		36		36		36		36		36	
Godness of fit		Adjusted R2	0,288		0,51		0,387		0,447		0,456		0,790		0,514		0,554		0,471		0,645		0,507		0,599	
		Hosmer and Lameshow Test (p-value)	5,983	*0,649*	*7,285*	*0,506*	7,216	*0,515*	11,407	*0,180*	5,154	*0,741*	33,851	*0,000*	4,314	*0,828*	6,542	*0,587*	7,130	*0,523*	3,058	*0,931*	2,375	*0,967*	3,569	*0,894*
		% correct	83,3		81,3		79,2		75,0		77,1		97,9		81,3		85,4		79,2		85,4		81,3		83,3	

Table A 2: Determinants of companies' competitiveness (dependent variable: top 50% more competitive companies according average sales per capita)

			Model 1A		Model 1B		Model 1C		Model 1D		Model 2A		Model 2B		Model 2C		Model 2D		Model 2A		Model 2B		Model 2C		Model 2D	
			beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*
IPR use	**Informal IPRs** (average importance of the IPR in ln)	Trade secret (dummy=1 if the firm uses this IPR; 0 otherwise)	-0,568	*0,503*	-1,183	*0,580*	-0,446	*0,809*	-0,560	*0,517*	-3,140	*0,100*	2,087	*0,674*	-2,469	*0,224*	-2,194	*0,281*	-1,948	*0,142*	-1,457	*0,572*	-2,548	*0,206*	-0,913	*0,568*
		Lead time (dummy=1 if the firm uses this IPR; 0 otherwise)									3,046	*0,214*	17,991	*0,378*	2,812	*0,424*	2,366	*0,334*								
		Complementary assets (dummy=1 if the firm uses this IPR; 0 otherwise)																	1,331	*0,488*	0,185	*0,954*	-0,448	*0,867*	-0,271	*0,916*
	Formal IPRs (average importance of the IPR in ln)	Patents (dummy=1 if the firm uses this IPR; 0 otherwise)	-2,801	*0,111*	-2,674	*0,418*	-4,438	*0,054*	-1,029	*0,715*	-5,478	*0,046*	-26,469	*0,344*	-5,176	*0,067*	-7,084	*0,039*	-3,961	*0,037*	-5,829	*0,070*	-4,152	*0,053*	-6,129	*0,041*
		Trademarks (dummy=1 if the firm uses this IPR; 0 otherwise)									-2,118	*0,302*	-10,024	*0,287*	-2,120	*0,366*	-4,217	*0,224*	-1,699	*0,388*	-3,460	*0,273*	-2,004	*0,396*	-3,795	*0,224*
		Industrial design (dummy=1 if the firm uses this IPR; 0 otherwise)									-19,133	*0,999*	-40,849	*0,996*	-20,214	*0,998*	-23,366	*0,998*	-20,077	*0,999*	-24,195	*0,998*	-21,223	*0,998*	-26,114	*0,998*
		Geographical indications (dummy=1 if the firm uses this IPR; 0 otherwise)									-1,256	*0,440*	-20,059	*0,391*	-2,233	*0,271*	-3,083	*0,265*	-0,889	*0,560*	-3,486	*0,288*	-1,863	*0,346*	-3,131	*0,260*
		Copyrights and rights related to copyright (dummy=1 if the firm uses this IPR; 0 otherwise)									-1,015	*0,479*	-15,398	*0,345*	-1,257	*0,468*	-2,957	*0,260*	-0,386	*0,785*	-2,726	*0,446*	-0,714	*0,640*	-3,603	*0,272*
	Interaction between IPRs type and Size/type of innovation	Informal*size			2,218	*0,269*	1,462	*0,366*					-6,868	*0,461*	0,725	*0,754*					1,730	*0,435*	2,304	*0,244*		
		Informal*ID			-8,047	*0,198*	-7,354	*0,087*					-37,230	*0,337*	-6,361	*0,296*					-10,223	*0,269*	-6,416	*0,302*		
		Formal*size			-2,102	*0,425*			-0,224	*0,918*			24,593	*0,400*			6,226	*0,369*			3,429	*0,693*			8,434	*0,290*
		Formal*ID			0,021	*0,998*			-6,970	*0,210*			43,519	*0,361*			-2,431	*0,782*			7,920	*0,538*			-3,846	*0,689*
Control variables	**Companies' characteristics**	Age (ln)	2,236	*0,040*	2,836	*0,044*	2,716	*0,033*	2,158	*0,051*	1,757	*0,219*	2,048	*0,533*	2,410	*0,163*	1,454	*0,380*	2,016	*0,145*	2,656	*0,207*	2,496	*0,146*	1,737	*0,285*
		Size (ln)	-0,135	*0,812*	-0,611	*0,658*	-1,106	*0,347*	0,153	*0,899*	0,222	*0,758*	-5,232	*0,379*	-0,197	*0,913*	-2,497	*0,420*	-0,053	*0,941*	-2,846	*0,381*	-1,470	*0,286*	-3,740	*0,283*
		Human capital (dummy=1 if the firm employs at least one PhD; 0 otherwise)	-0,236	*0,838*	-0,211	*0,867*	-0,482	*0,688*	-0,167	*0,880*	1,887	*0,419*	3,408	*0,502*	1,493	*0,516*	1,083	*0,661*	0,654	*0,705*	0,030	*0,991*	0,679	*0,721*	-0,307	*0,881*
		R&D intensity (dummy=1 if the firm has a R&D intensity above 50%)	-2,151	*0,069*	2,590	*0,381*	1,880	*0,466*	0,367	*0,859*	-2,998	*0,151*	-1,480	*0,806*	1,001	*0,813*	-2,758	*0,394*	-1,715	*0,293*	1,312	*0,777*	1,575	*0,708*	-1,512	*0,610*
	Context	Sector (dummy=1 if the companies operates in Computing sector; 0 otherwise)	-3,007	*0,023*	-2,540	*0,033*	-2,602	*0,028*	-2,696	*0,027*	-4,003	*0,024*	-10,192	*0,318*	-4,162	*0,036*	-4,728	*0,024*	-3,653	*0,023*	-4,296	*0,043*	-4,269	*0,029*	-4,549	*0,022*
		Region (dummy=1 if the firm is located in UPTEC; 0 otherwise)	0,825	*0,424*	0,802	*0,499*	0,938	*0,416*	0,501	*0,661*	2,247	*0,243*	0,163	*0,966*	2,095	*0,320*	2,634	*0,224*	1,575	*0,333*	1,518	*0,479*	2,037	*0,309*	1,905	*0,300*
N			48		48		48		48		48		48		48		48		48		48		48		48	
Top competitiveness companies			24		24		24		24		24		24		24		24		24		24		24		24	
Other			24		24		24		24		24		24		24		24		24		24		24		24	
Godness of fit		Adjusted R2	0,610		0,680		0,667		0,643		0,770		0,822		0,784		0,781		0,753		0,788		0,776		0,769	
		Hosmer and Lameshow Test (p-value)	10,293	*0,245*	7,535	*0,480*	5,104	*0,746*	5,048	*0,752*	4,139	*0,844*	6,572	*0,583*	2,346	*0,969*	8,336	*0,401*	4,164	*0,842*	5,256	*0,730*	1,079	*0,998*	4,826	*0,776*
		% correct	85,4		87,5		87,5		87,5		87,5		85,4		85,4		89,6		91,7		89,6		89,6		89,6	

Table A 3: Determinants of companies' competitiveness (dependent variable: top 25% more competitive companies according average GVA per capita)

			Model 1A		Model 1B		Model 1C		Model 1D		Model 2A		Model 2B		Model 2C		Model 2D		Model 2A		Model 2B		Model 2C		Model 2D	
			beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*
IPR use	**Informal IPRs** (average importance of the IPR in ln)	Trade secret (dummy=1 if the firm uses this IPR; 0 otherwise)	-2,168	*0,023*	-0,078	*0,968*	-0,296	*0,830*	-2,309	*0,020*	-0,927	*0,501*	2,343	*0,463*	-0,150	*0,934*	-2,208	*0,256*	-0,382	*0,748*	1,157	*0,472*	0,265	*0,873*	-0,793	*0,541*
		Lead time (dummy=1 if the firm uses this IPR; 0 otherwise)									-3,927	*0,044*	-1,618	*0,652*	-1,496	*0,543*	-5,364	*0,043*								
		Complementary assets (dummy=1 if the firm uses this IPR; 0 otherwise)																	-3,143	*0,051*	2,025	*0,357*	-1,222	*0,534*	-4,198	*0,040*
	Formal IPRs (average importance of the IPR in ln)	Patents (dummy=1 if the firm uses this IPR; 0 otherwise)	2,220	*0,148*	0,668	*0,807*	2,726	*0,113*	2,612	*0,176*	2,646	*0,106*	-3,881	*0,523*	3,317	*0,087*	2,296	*0,392*	1,882	*0,144*	-4,170	*0,110*	3,133	*0,091*	1,537	*0,491*
		Trademarks (dummy=1 if the firm uses this IPR; 0 otherwise)									-1,168	*0,360*	-3,389	*0,191*	-1,179	*0,469*	-2,892	*0,149*	-0,463	*0,694*	-2,298	*0,152*	-0,906	*0,573*	-1,253	*0,391*
		Industrial design (dummy=1 if the firm uses this IPR; 0 otherwise)									-0,655	*0,741*	-8,897	*0,976*	0,142	*0,956*	-1,627	*0,548*	-0,451	*0,805*	-4,370	*0,512*	0,186	*0,940*	-0,868	*0,731*
		Geographical indications (dummy=1 if the firm uses this IPR; 0 otherwise)									2,252	*0,179*	-1,699	*0,788*	3,753	*0,110*	4,163	*0,159*	1,683	*0,207*	-1,470	*0,483*	3,668	*0,106*	3,430	*0,136*
		Copyrights and rights related to copyright (dummy=1 if the firm uses this IPR; 0 otherwise)									1,651	*0,336*	4,106	*0,394*	0,702	*0,725*	3,872	*0,176*	0,743	*0,623*	-0,926	*0,589*	0,387	*0,827*	2,528	*0,245*
	Interaction between IPRs type and Size/type of innovation	Informal*size			-2,128	*0,430*	-2,135	*0,082*					-1,340	*0,699*	-2,815	*0,124*					-2,592	*0,265*	-3,032	*0,074*		
		Informal*ID			-33,477	*0,086*	-0,625	*0,842*					-64,445	*0,291*	-0,237	*0,960*					-25,960	*0,150*	-0,109	*0,982*		
		Formal*size			1,211	*0,745*			-1,159	*0,480*			3,707	*0,518*			-2,053	*0,418*			4,925	*0,154*			-2,377	*0,322*
		Formal*ID			48,278	*0,052*			4,237	*0,309*			101,800	*0,216*			14,423	*0,130*			49,785	*0,038*			11,170	*0,164*
Control variables	**Companies' characteristics**	Age (ln)	0,787	*0,420*	2,325	*0,176*	1,051	*0,307*	1,089	*0,288*	2,299	*0,107*	3,435	*0,286*	3,509	*0,074*	4,356	*0,091*	1,988	*0,118*			3,541	*0,070*	3,604	*0,077*
		Size (ln)	0,164	*0,758*	0,060	*0,963*	1,414	*0,114*	0,715	*0,450*	-0,324	*0,645*	-0,318	*0,874*	1,204	*0,332*	0,601	*0,648*	0,292	*0,657*	-0,942	*0,471*	1,618	*0,113*	1,654	*0,244*
		Human capital (dummy=1 if the firm employs at least one PhD; 0 otherwise)	0,362	*0,748*	1,820	*0,425*	0,530	*0,669*	0,540	*0,648*	0,075	*0,960*	1,073	*0,748*	0,889	*0,652*	1,207	*0,548*	-0,387	*0,768*	1,019	*0,630*	0,623	*0,745*	0,044	*0,977*
		R&D intensity (dummy=1 if the firm has a R&D intensity above 50%)	-1,186	*0,306*	-10,645	*0,143*	-0,745	*0,766*	-3,300	*0,214*	-0,021	*0,989*	-21,609	*0,942*	-0,161	*0,957*	-6,911	*0,190*	-0,909	*0,534*	-14,850	*0,116*	-0,577	*0,852*	-6,409	*0,161*
	Context	Sector (dummy=1 if the companies operates in Computing sector; 0 otherwise)	-0,495	*0,639*	0,806	*0,640*	-0,175	*0,882*	-0,509	*0,658*	-0,005	*0,997*	-2,995	*0,539*	1,269	*0,503*	-0,271	*0,900*	-0,446	*0,739*	-1,122	*0,532*	1,099	*0,569*	-0,781	*0,666*
		Region (dummy=1 if the firm is located in UPTEC; 0 otherwise)	-1,304	*0,207*	-2,773	*0,083*	-1,814	*0,117*	-1,308	*0,220*	-1,134	*0,265*	-4,123	*0,219*	-1,358	*0,234*	-0,965	*0,359*	-1,110	*0,268*			-1,380	*0,225*	-0,917	*0,367*
N			48		48		48		48		48		48		48		48		48		48		48		48	
Top competitiveness companies			12		12		12		12		12		12		12		12		12		12		12		12	
Other			36		36		36		36		36		36		36		36		36		36		36		36	
Godness of fit		Adjusted R2	0,301		0,612		0,401		0,341		0,374		0,676		0,462		0,465		0,331		0,567		0,463		0,418	
		Hosmer and Lameshow Test (p-value)	12,203	*0,142*	4,729	*0,786*	3,573	*0,893*	4,441	*0,815*	5,324	*0,722*	3,758	*0,878*	6,009	*0,646*	1,590	*0,991*	1,875	*0,985*	7,925	*0,436*	6,396	*0,603*	2,119	*0,977*
		% correct	75,0		85,4		79,2		81,3		75,0		87,5		79,2		83,3		79,2		85,4		75,0		79,2	

Table A 4: Determinants of companies' competitiveness (dependent variable: top 50% more competitive companies according average GVA per capita)

			Model 1A		Model 1B		Model 1C		Model 1D		Model 2A		Model 2B		Model 2C		Model 2D		Model 2A		Model 2B		Model 2C		Model 2D	
			beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*
IPR use	**Informal IPRs** (average importance of the IPR in ln)	Trade secret (dummy=1 if the firm uses this IPR; 0 otherwise)	-1,244	*0,115*	-2,385	*0,151*	-1,229	*0,368*	-1,306	*0,108*	-0,842	*0,354*	-1,478	*0,335*	-0,810	*0,486*	-1,191	*0,241*	-0,913	*0,307*	-1,180	*0,417*	-0,700	*0,534*	-1,270	*0,203*
		Lead time (dummy=1 if the firm uses this IPR; 0 otherwise)									-1,082	*0,333*	-1,715	*0,475*	-1,468	*0,448*	-0,927	*0,449*								
		Complementary assets (dummy=1 if the firm uses this IPR; 0 otherwise)											-0,447	*0,830*					-1,259	*0,347*	-1,029	*0,573*	-1,159	*0,497*	-0,997	*0,489*
	Formal IPRs (average importance of the IPR in ln)	Patents (dummy=1 if the firm uses this IPR; 0 otherwise)	0,448	*0,663*	0,330	*0,899*	0,397	*0,709*	0,804	*0,670*	-0,042	*0,965*	-1,417	*0,425*	0,167	*0,871*	-1,436	*0,336*	-0,071	*0,941*	-1,660	*0,338*	0,103	*0,919*	-1,394	*0,348*
		Trademarks (dummy=1 if the firm uses this IPR; 0 otherwise)									-0,359	*0,693*	-1,343	*0,363*	-0,393	*0,691*	-1,219	*0,330*	-0,160	*0,867*	-1,214	*0,403*	-0,116	*0,906*	-1,036	*0,416*
		Industrial design (dummy=1 if the firm uses this IPR; 0 otherwise)									1,004	*0,438*	-1,143	*0,608*	1,017	*0,446*	-0,562	*0,768*	1,099	*0,397*	-1,106	*0,622*	1,192	*0,369*	-0,411	*0,827*
		Geographical indications (dummy=1 if the firm uses this IPR; 0 otherwise)									-0,023	*0,979*	-0,647	*0,665*	-0,356	*0,724*	-0,125	*0,918*	0,101	*0,912*	-0,726	*0,620*	-0,166	*0,873*	0,024	*0,985*
		Copyrights and rights related to copyright (dummy=1 if the firm uses this IPR; 0 otherwise)									-0,165	*0,866*	-0,858	*0,661*	-0,292	*0,795*	-0,632	*0,653*	-0,481	*0,630*	-1,399	*0,420*	-0,675	*0,527*	-0,827	*0,559*
	Interaction between IPRs type and Size/type of innovation	Informal*size			2,978	*0,093*	0,098	*0,924*					2,707	*0,172*	0,605	*0,649*					1,935	*0,245*	0,223	*0,825*		
		Informal*ID			-11,198	*0,069*	-0,505	*0,817*					-10,438	*0,072*	-1,797	*0,570*					-10,351	*0,082*	-1,770	*0,575*		
		Formal*size			-3,671	*0,112*			-1,138	*0,464*			-1,683	*0,576*			0,242	*0,908*			-1,293	*0,662*			0,106	*0,959*
		Formal*ID			16,298	*0,052*			3,490	*0,248*			19,484	*0,044*			7,703	*0,109*			19,184	*0,046*			7,622	*0,113*
Control variables	**Companies' characteristics**	Age (ln)	1,012	*0,223*	1,706	*0,107*	1,012	*0,224*	1,194	*0,165*	1,065	*0,247*	1,733	*0,136*	1,080	*0,245*	1,321	*0,186*	1,079	*0,245*	1,698	*0,140*	1,105	*0,237*	1,351	*0,181*
		Size (ln)	-0,086	*0,848*	-0,488	*0,663*	-0,157	*0,854*	0,390	*0,657*	-0,183	*0,709*	-1,411	*0,352*	-0,658	*0,560*	-0,440	*0,723*	-0,138	*0,769*	-0,967	*0,458*	-0,322	*0,697*	-0,314	*0,786*
		Human capital (dummy=1 if the firm employs at least one PhD; 0 otherwise)	-0,582	*0,500*	-0,868	*0,417*	-0,621	*0,480*	-0,407	*0,655*	-0,458	*0,634*	-0,878	*0,489*	-0,702	*0,497*	-0,277	*0,806*	-0,430	*0,656*	-0,846	*0,506*	-0,640	*0,538*	-0,236	*0,834*
		R&D intensity (dummy=1 if the firm has a R&D intensity above 50%)	-1,070	*0,195*	-1,756	*0,383*	-0,773	*0,614*	-2,433	*0,130*	-1,082	*0,270*	-2,902	*0,304*	0,002	*0,999*	-3,818	*0,069*	-1,266	*0,201*	-3,021	*0,279*	-0,284	*0,887*	-3,940	*0,061*
	Context	Sector (dummy=1 if the companies operates in Computing sector; 0 otherwise)	0,296	*0,738*	0,966	*0,349*	0,318	*0,725*	0,406	*0,669*	0,412	*0,674*	0,839	*0,443*	0,420	*0,678*	0,466	*0,659*	0,471	*0,636*	0,916	*0,396*	0,539	*0,592*	0,524	*0,622*
		Region (dummy=1 if the firm is located in UPTEC; 0 otherwise)	-0,729	*0,330*	-0,565	*0,515*	-0,736	*0,337*	-0,645	*0,434*	-0,688	*0,389*	-0,708	*0,437*	-0,816	*0,331*	-0,347	*0,684*	-0,695	*0,389*	-0,693	*0,445*	-0,820	*0,330*	-0,338	*0,693*
N			48		48		48		48		48		48		48		48		48		48		48		48	
Top competitiveness companies			23		23		23		23		23		23		23		23		23		23		23		23	
Other			25		25		25		25		25		25		25		25		25		25		25		25	
Godness of fit		Adjusted R2	0,292		0,442		0,293		0,334		0,309		0,458		0,318		0,37		0,308		0,448		0,315		0,369	
		Hosmer and Lameshow Test (p-value)	13,756	*0,088*	11,377	*0,187*	14,174	*0,077*	7,530	*0,481*	5,548	*0,698*	4,950	*0,763*	7,818	*0,451*	12,485	*0,131*	8,210	*0,413*	6,690	*0,570*	14,498	*0,070*	19,132	*0,014*
		% correct	70,8		72,9		72,9		72,9		70,8		72,9		70,8		70,8		79,2		77,1		79,2		72,9	

Table A 5: Determinants of companies' competitiveness (dependent variable: top 25% more competitive companies according average EBITDA)

			Model 1A		Model 1B		Model 1C		Model 1D		Model 2A		Model 2B		Model 2C		Model 2D		Model 2A		Model 2B		Model 2C		Model 2D	
			beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*
IPR use	**Informal IPRs** (average importance of the IPR in ln)	Trade secret (dummy=1 if the firm uses this IPR; 0 otherwise)	-0,767	*0,330*	-1,318	*0,384*	-0,630	*0,628*	-0,775	*0,320*	-0,071	*0,943*	4,734	*0,074*	0,757	*0,572*	-0,422	*0,691*	0,109	*0,914*	0,709	*0,605*	0,356	*0,778*	-0,294	*0,783*
		Lead time (dummy=1 if the firm uses this IPR; 0 otherwise)									0,048	*0,968*	12,524	*0,024*	1,510	*0,467*	0,100	*0,932*								
		Complementary assets (dummy=1 if the firm uses this IPR; 0 otherwise)																	-0,718	*0,592*	0,568	*0,778*	-0,407	*0,811*	-0,642	*0,652*
	Formal IPRs (average importance of the IPR in ln)	Patents (dummy=1 if the firm uses this IPR; 0 otherwise)	0,150	*0,900*	1,161	*0,573*	0,052	*0,966*	0,990	*0,595*	-1,375	*0,333*	-21,313	*0,019*	-1,339	*0,385*	-3,871	*0,154*	-1,266	*0,376*	-5,686	*0,113*	-1,160	*0,434*	-3,863	*0,173*
		Trademarks (dummy=1 if the firm uses this IPR; 0 otherwise)									-1,161	*0,272*	-7,019	*0,029*	-0,903	*0,418*	-2,268	*0,114*	-0,955	*0,386*	-2,701	*0,111*	-0,885	*0,430*	-2,063	*0,168*
		Industrial design (dummy=1 if the firm uses this IPR; 0 otherwise)									-0,004	*0,998*	-14,893	*0,034*	0,300	*0,847*	-2,269	*0,332*	0,042	*0,978*	-4,280	*0,177*	0,118	*0,938*	-2,240	*0,350*
		Geographical indications (dummy=1 if the firm uses this IPR; 0 otherwise)									0,306	*0,768*	-0,859	*0,638*	0,415	*0,721*	-0,056	*0,968*	0,589	*0,605*	-0,199	*0,906*	0,523	*0,674*	0,294	*0,850*
		Copyrights and rights related to copyright (dummy=1 if the firm uses this IPR; 0 otherwise)									-0,109	*0,921*	-12,698	*0,019*	-0,593	*0,639*	-1,065	*0,483*	-0,168	*0,882*	-2,285	*0,232*	-0,266	*0,822*	-1,102	*0,488*
	Interaction between IPRs type and Size/type of innovation	Informal*size			1,256	*0,404*	0,186	*0,866*					-9,479	*0,029*	-1,154	*0,449*					-0,450	*0,777*	-0,203	*0,861*		
		Informal*ID			-4,237	*0,386*	-1,478	*0,603*					-12,493	*0,116*	-1,000	*0,783*					-6,412	*0,291*	-0,669	*0,855*		
		Formal*size			-1,976	*0,335*			-0,904	*0,566*			15,829	*0,021*			1,604	*0,492*			2,975	*0,310*			1,554	*0,513*
		Formal*ID			4,410	*0,513*			-0,116	*0,975*			63,808	*0,036*			9,318	*0,240*			21,869	*0,133*			9,846	*0,246*
Control variables	**Companies' characteristics**	Age (ln)	0,898	*0,361*	0,955	*0,353*	0,852	*0,393*	0,945	*0,353*	0,892	*0,434*	-0,920	*0,591*	1,088	*0,366*	0,722	*0,551*	1,051	*0,375*	0,787	*0,522*	1,068	*0,371*	0,861	*0,491*
		Size (ln)	0,878	*0,100*	1,007	*0,283*	0,775	*0,352*	1,288	*0,144*	1,119	*0,072*	2,392	*0,154*	1,923	*0,134*	0,464	*0,688*	1,094	*0,062*	0,207	*0,869*	1,175	*0,174*	0,484	*0,681*
		Human capital (dummy=1 if the firm employs at least one PhD; 0 otherwise)	-0,753	*0,495*	-0,886	*0,458*	-0,860	*0,442*	-0,662	*0,552*	-1,054	*0,375*	-3,507	*0,071*	-1,126	*0,361*	-1,327	*0,314*	-1,044	*0,380*	-1,969	*0,192*	-1,083	*0,376*	-1,304	*0,322*
		R&D intensity (dummy=1 if the firm has a R&D intensity above 50%)	-0,864	*0,424*	-0,291	*0,889*	-0,091	*0,960*	-0,662	*0,727*	-0,853	*0,466*	-24,027	*0,031*	-0,457	*0,842*	-4,529	*0,202*	-0,981	*0,423*	-6,819	*0,180*	-0,570	*0,811*	-4,951	*0,208*
	Context	Sector (dummy=1 if the companies operates in Computing sector; 0 otherwise)	-0,742	*0,459*	-0,420	*0,693*	-0,640	*0,530*	-0,636	*0,538*	-0,955	*0,406*	-0,404	*0,795*	-0,670	*0,582*	-1,270	*0,315*	-0,930	*0,417*	-0,971	*0,452*	-0,829	*0,485*	-1,242	*0,326*
		Region (dummy=1 if the firm is located in UPTEC; 0 otherwise)	-0,943	*0,305*	-1,104	*0,261*	-0,967	*0,306*	-1,072	*0,263*	-0,375	*0,679*	-0,335	*0,821*	-0,675	*0,508*	0,149	*0,886*	-0,464	*0,611*	-0,317	*0,783*	-0,577	*0,560*	0,083	*0,937*
		N	48		48		48		48		48		48		48		48		48		48		48		48	
		Top competitiveness companies	11		11		11		11		11		11		11		11		11		11		11		11	
		Other	37		37		37		37		37		37		37		37		37		37		37		37	
Godness of fit		Adjusted R2	0,231		0,268		0,239		0,241		0,276		0,559		0,299		0,329		0,283		0,385		0,286		0,334	
		Hosmer and Lameshow Test (p-value)	6,038	*0,643*	2,671	*0,953*	5,975	*0,650*	7,952	*0,438*	11,205	*0,190*	2,789	*0,947*	10,131	*0,256*	1,385	*0,994*	9,728	*0,285*	1,525	*0,992*	9,976	*0,267*	1,368	*0,995*
		% correct	79,2		75		75		77,1		72,9		85,4		75,0		79,2		75,0		83,3		75,0		79,2	

Table A 6: Determinants of companies' competitiveness (dependent variable: top 50% more competitive companies according average EBITDA)

			Model 1A		Model 1B		Model 1C		Model 1D		Model 2A		Model 2B		Model 2C		Model 2D		Model 2A		Model 2B		Model 2C		Model 2D	
			beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*	beta	*p-value*
IPR use	**Informal IPRs** (average importance of the IPR in ln)	Trade secret (dummy=1 if the firm uses this IPR; 0 otherwise)	-0,350	*0,635*	*-0,549*	*0,697*	-0,586	*0,650*	-0,360	*0,625*	-1,748	*0,090*	-5,446	*0,053*	-2,793	*0,045*	-2,978	*0,051*	-1,682	*0,092*	-5,788	*0,056*	-2,818	*0,045*	-2,861	*0,054*
		Lead time (dummy=1 if the firm uses this IPR; 0 otherwise)									1,072	*0,376*	0,239	*0,908*	0,411	*0,825*	2,061	*0,161*								
		Complementary assets (dummy=1 if the firm uses this IPR; 0 otherwise)																	1,230	*0,358*	1,403	*0,442*	0,794	*0,642*	2,390	*0,148*
	Formal IPRs (average importance of the IPR in ln)	Patents (dummy=1 if the firm uses this IPR; 0 otherwise)	-1,138	*0,246*	*-1,614*	*0,384*	-1,148	*0,263*	-1,509	*0,350*	-1,499	*0,190*	-2,729	*0,141*	-2,151	*0,102*	-3,062	*0,083*	-1,434	*0,188*	-3,281	*0,099*	-2,220	*0,094*	-3,199	*0,074*
		Trademarks (dummy=1 if the firm uses this IPR; 0 otherwise)									-1,499	*0,153*	-3,790	*0,053*	-2,079	*0,110*	-2,860	*0,053*	-1,681	*0,138*	-4,514	*0,055*	-2,282	*0,107*	-3,288	*0,044*
		Industrial design (dummy=1 if the firm uses this IPR; 0 otherwise)									0,885	*0,528*	2,884	*0,343*	0,941	*0,526*	1,004	*0,659*	0,841	*0,548*	3,111	*0,333*	0,971	*0,504*	0,719	*0,744*
		Geographical indications (dummy=1 if the firm uses this IPR; 0 otherwise)									-0,025	*0,978*	1,456	*0,402*	0,408	*0,696*	0,425	*0,750*	-0,173	*0,857*	1,277	*0,481*	0,279	*0,795*	0,032	*0,981*
		Copyrights and rights related to copyright (dummy=1 if the firm uses this IPR; 0 otherwise)									-0,444	*0,656*	1,159	*0,548*	0,133	*0,910*	-0,690	*0,588*	-0,115	*0,911*	1,412	*0,429*	0,309	*0,775*	-0,084	*0,952*
	Interaction between IPRs type and Size/type of innovation	Informal*size			*0,378*	*0,764*	0,196	*0,848*					2,517	*0,259*	0,129	*0,923*					2,435	*0,214*	0,060	*0,958*		
		Informal*ID			*-0,889*	*0,776*	0,117	*0,959*					0,928	*0,786*	4,251	*0,152*					0,426	*0,904*	4,312	*0,152*		
		Formal*size			*-0,151*	*0,918*			0,095	*0,938*			-4,565	*0,250*			-1,171	*0,605*			-4,796	*0,234*			-0,895	*0,682*
		Formal*ID			*1,925*	*0,625*			1,177	*0,685*			9,497	*0,130*			8,675	*0,071*			11,298	*0,112*			9,041	*0,068*
Control variables	**Companies' characteristics**	Age (ln)	0,395	*0,610*	*0,494*	*0,544*	0,381	*0,624*	0,453	*0,566*	0,328	*0,717*	1,296	*0,323*	0,327	*0,731*	0,754	*0,491*	0,353	*0,693*	1,250	*0,343*	0,320	*0,736*	0,701	*0,525*
		Size (ln)	0,301	*0,506*	*0,041*	*0,966*	0,160	*0,855*	0,218	*0,781*	0,332	*0,515*	0,629	*0,616*	0,255	*0,808*	0,740	*0,533*	0,268	*0,585*	0,767	*0,524*	0,292	*0,734*	0,480	*0,676*
		Human capital (dummy=1 if the firm employs at least one PhD; 0 otherwise)	-0,238	*0,778*	*-0,255*	*0,770*	-0,233	*0,783*	-0,265	*0,760*	0,999	*0,372*	3,583	*0,132*	1,545	*0,245*	2,259	*0,195*	0,935	*0,394*	4,003	*0,134*	1,578	*0,234*	2,131	*0,210*
		R&D intensity (dummy=1 if the firm has a R&D intensity above 50%)	-0,866	*0,297*	*-1,069*	*0,533*	-0,961	*0,553*	-1,348	*0,347*	-1,258	*0,254*	-5,461	*0,066*	-3,668	*0,077*	-4,717	*0,052*	-1,060	*0,319*	-5,977	*0,068*	-3,617	*0,080*	-4,562	*0,059*
	Context	Sector (dummy=1 if the companies operates in Computing sector; 0 otherwise)	-1,583	*0,091*	*-1,571*	*0,106*	-1,613	*0,095*	-1,620	*0,091*	-1,118	*0,272*	-0,883	*0,496*	-1,378	*0,220*	-0,905	*0,449*	-1,158	*0,257*	-0,974	*0,460*	-1,430	*0,204*	-1,027	*0,391*
		Region (dummy=1 if the firm is located in UPTEC; 0 otherwise)	1,083	*0,161*	*1,212*	*0,135*	1,114	*0,156*	1,174	*0,145*	1,424	*0,130*	3,132	*0,046*	1,951	*0,076*	2,308	*0,055*	1,404	*0,129*	3,495	*0,050*	2,008	*0,073*	2,323	*0,054*
N			48		48		48		48		48		48		48		48		48		48		48		48	
Top competitiveness companies			23		23		23		23		23		23		23		23		23		23		23		23	
Other			25		25		25		25		25		25		25		25		25		25		25		25	
Godness of fit		Adjusted R2	0,256		0,262		0,257		0,26		0,356		0,468		0,404		0,434		0,357		0,478		0,407		0,437	
		Hosmer and Lameshow Test (p-value)	15,390	*0,052*	*10,554*	*0,228*	12,000	*0,151*	9,021	*0,341*	5,355	*0,719*	8,859	*0,354*	10,576	*0,227*	7,283	*0,506*	5,729	*0,678*	10,694	*0,220*	6,293	*0,614*	11,357	*0,182*
		% correct	60,4		58,3		60,4		62,5		70,8		75,0		70,8		72,9		70,8		72,9		66,7		66,7	